Scoping Study and Work Plan

for a

Residential New Construction Market Effects Study

Prepared by
RLW Analytics
Nexus Market Research, Inc.
Summit Blue Consulting
Itron, Inc.
The Cadmus Group, Inc.

For the
California Public Utilities Commission
Energy Division

July 31, 2008

Contents

1 Introduction

This document presents the results of a scoping study, including a work plan intended to guide a larger residential new construction (RNC) market effects study, as described in the "Residential New Construction Market Effects Study: Final Study Plan," (Version 2, February 20, 2008) prepared by Stephen Meyers for the California Institute for Energy and Environment (Oakland, CA) and Ed Vine, the Project Manager.[1] This scoping study was developed by RLW and its associates, Nexus Market Research, Inc. (NMR), Summit Blue Consulting, Itron, and The Cadmus Group.

The California Public Utilities Commission's (CPUC) Market Effects Evaluation Protocol presents a definition of market effects as "A change in the structure of a market or the behavior of participants in a market that is reflective of an increase in the adoption of energy-efficient products, services, or practices and is causally related to market intervention(s)." It is also useful to consider the definition of market effects offered by Eto, Prahl, and Schlegel: "a reduction in market barriers resulting from a market intervention, as evidenced by a set of market effects, that lasts after the intervention has been withdrawn, reduced, or changed."[2] This study adds the criterion of lasting, or sustainability, to the Protocol's definition of market effects, and uses the combined definition to guide this analysis.

As listed in the Final Study Plan, the objectives of the overall market effects study—including the scoping study and well as later steps—are as follows:

- Understand the market effects of California's utility energy efficiency programs on construction practices for new single-family homes.
- Quantify the energy savings caused by the above market effects occurring in the years 2006-2008, with special attention to non-participant spillover.[3]

---

[1] Hereafter, referred to as the *Final Study Plan*.

[2] Eto, J., R. Prahl, and J. Schlegel. 1996. *A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs.* Berkeley, Calif.: Lawrence Berkeley National Laboratory.

[3] In CPUC Decision 07-10-032 (Oct. 18, 2007), the CPUC directed its staff and consultants to examine non-participant spillover, while the CPUC's Evaluation, Monitoring and Valuation (EM&V) contractors were directed to evaluate participant spillover. In this decision, the savings from program participants who undertake energy efficiency improvements beyond the scope of the utility's program are defined as participant spillover. In contrast, the savings from those not directly participating in a utility program who reduce their energy use after being influenced by a utility program are defined as non-participant spillover. For purposes of this study, gross savings are defined as what would have happened in the absence of the IOU's 2006-2008 programs—the hypothetical baseline—and net savings are defined as the difference between what actually occurred and this baseline.

- Support the CPUC's strategic planning efforts by clarifying whether energy savings from non-participant spillover can be quantified with sufficient reliability to be treated as a resource and, potentially, afforded shareholder incentive treatment.
- Additionally, this approach recognizes the following study criteria:
    - Being performed in a manner that is consistent with the CPUC protocols for market effects evaluations.
    - Being performed primarily as an addition to the scope of work for the New Construction/Codes & Standards (NC/CS) Monitoring and Verification (M&V) team. The main reason for this approach is that there are extensive synergies between the work already proposed to be performed by that team and the work needed for the current study. However, the planning, analysis, and reporting for the two projects will be kept separate.
    - Being performed on a timeline that roughly coincides with that for the M&V study for New Construction/Codes & Standards because of the overlap between the two studies, the coordinated data collection efforts, and the administrative arrangement described above. A draft report for Phase 1 will be delivered on November 26, 2008 and a final Phase 1 report on December 16, 2008. Due to the CPUC's need for timely results to inform its strategic planning efforts, a draft Phase 2 report will be provided by October 9, 2009, and a final Phase 2 report by November 2, 2009, ahead of the February 2010 date envisioned for the final report on the New Construction/Codes & Standards M&V study.

As pointed out in the Final Study Plan, the California protocol for market effects evaluations strongly suggests conducting a scoping study before conducting a market effects study. As the protocol says:

> *The appropriate approach for a market effects study cannot be readily determined without a scoping study to define the market to be studied, develop a market theory to test in the analysis, assess data availability for the market effects study, specify a model of market change, develop a methodology for data collection and recommend an analysis approach. (p. 149.)*

Components of such a scoping study, when performed at an enhanced level of rigor, are as follows:

> *Define the market by its location, the utilities involved, the equipment, behaviors, sector and the program years of interest. Develop market theory and logic model. Detail indicators. Identify available secondary data and primary data that can be used to track changes in indicators. Outline data collection approach. Recommend hypotheses to test in the market effects study. Recommend the analysis approach most likely to be effective. (p. 150.)*

Accordingly, the specific objectives of this scoping study are as follows:

- Describe and lay out a theory and logic model of the California RNC market
- Describe the utilities' 2006-2008 RNC programs
- Describe and lay out a theory and logic model of the utilities' programs in relation to the market
    - Identify expected outcomes of program efforts
    - Delineate indicators that can be measured in order to establish whether expected outcomes have occurred
    - Recommend alternative hypotheses to test in order to assess whether observed market changes can reasonably be attributed to market forces or actors outside the utilities' programs
- Develop a plan for data collection and analysis to assess the market effects of the utilities' new construction programs

The plans for the data collection and analysis as outlined in this scoping study are subject to revision after a public workshop, as called for in the Market Effects Protocol and the Final Study Plan.

The sources of information for this scoping study are as follows:

- Interviews with six managers of the California utilities' programs and five other utility staff members:
    - For Pacific Gas and Electric (PG&E), Pat Eilert for the Codes and Standards (C&S) Support Program and Adam Neugebauer of Consol for the Duct and Cover Program.
    - For Sempra utilities (San Diego Gas & Electric [SDG&E] and Southern California Gas [SCG]), Chip Fox for the RNC Program and Lance DeLaura for the Codes and Standards Support Program.
    - For Southern California Edison (SCE), John Morton (with Jon Budner and Kathleen Gumbleton) for the RNC Program and Randall Higa, (with Steve Galanter and Kathleen Gumbleton) for the Codes and Standards Support Program. Gregg Ander (SCE Vice Chair) provided additional comments separately.
- Interviews with 14 experts on the RNC industry:
    - Doug Beaman, Beaman and Associates
    - Mark Berman, Davis Energy Group
    - Joe Deringer, ADM Associates
    - Dave Hewitt, New Buildings Institute

  - Marshall Hunt, University of California (UC) Davis Western Cooling Center
  - Aleisha Khan, Building Codes Assistance Project
  - Doug Mahone and Julieann Summerford, Heschong-Mahone Group
  - Jim Parks and Wade Hughes, Sacramento Municipal Utility District (SMUD) RNC Programs
  - Zippy Penaranda, California Living and Energy
  - John Proctor, Proctor Engineering
  - Robert Scott, California Home Energy Rating Service (CHEERS)
  - Rick Wylie, Beutler Mechanical

- Review of previous directly related market effects studies of California utilities' RNC Programs:
  - Quantum Consulting, Inc. *Statewide Residential New Construction Utility Program Comparison Study. California State-Level Market Assessment and Evaluation Study. Final Report*. P1869-114. May 31, 2000.
  - Regional Economic Research, Inc. *1998 PG&E Comfort Home Program Market Baseline and Market Effects Study*. PG&E Study ID #420ms-e. June 30, 1999.
- Review of evaluations of new construction programs outside California:
  - Conant, Dorothy. *The Massachusetts ENERGY STAR Homes Program: Program Theory*, Prepared for the Massachusetts ENERGY STAR Homes Program Joint Management Committee. May 2002.
  - Nexus Market Research, Inc., Dorothy Conant, Research Into Action, Inc., Ben Bronfman, and Shel Feldman Management Consulting. *Multi-Year Program Evaluation and Market Progress Reporting (MPER) Plan for the Massachusetts ENERGY STAR Homes Program*. Prepared for Fitchburg Gas & Electric Light Company, National Grid, NSTAR Electric, Western Massachusetts Electric Company. November 2001.
  - Massachusetts ENERGY STAR Homes Program Joint Management Committee. *ENERGY STAR® Homes Program: The Massachusetts Program Design and Market Transformation Plan 2003-2007*. August 1, 2002.
  - Nexus Market Research, Inc. and Dorothy Conant. *Evaluation of the Massachusetts ENERGY STAR® Homes Program: Findings and Analysis, Final Report.* Prepared for Joint Management Committee. May 2007.
  - Nexus Market Research, Inc., Dorothy Conant, Shel Feldman Management Consulting, GDS Associates, Inc., Megdal & Associates. *Evaluation of the*

Massachusetts ENERGY STAR® Homes Program: Findings and Analysis, Final Report. Prepared for The Joint Management Committee. March 2003.

- Long Island Power Authority (LIPA). *Appendix F: LIPA New York ENERGY STAR Labeled Homes Program and HPES Baseline Study: Long Term Goals, Program Theory and Market Effects*. Draft report for evaluation in progress. Emailed by Ann Clarke, LIPA, May 14, 2008.
- KEMA. *Final Report: Phase 2 Evaluation of the Efficiency Vermont Residential Programs*. Prepared for the Vermont Department of Public Service. December 2005.
- KEMA. *Final Report: Phase 1 Evaluation of the Efficiency Vermont Residential New Construction Program*. Prepared for the Vermont Department of Public Service. October 14, 2003.
- PA Consulting Group. *Wisconsin ENERGY STAR® Homes Program: Third Interim Evaluation Report*. Prepared for State of Wisconsin, Department of Administration, Division of Energy. April 20, 2001.
- PA Government Services, Inc. *Focus on Energy Statewide Evaluation. Wisconsin ENERGY STAR® Homes Program: Evaluation Findings. Final Report.* Prepared for State of Wisconsin, Department of Administration, Division of Energy. March 31, 2003.
- ECONorthwest. *ENERGY STAR Homes Northwest Program First Market Progress Evaluation Report.* Prepared for the Northwest Energy Efficiency Alliance. March 29, 2005.
- Opinion Dynamics Corporation. *Process Evaluation of the Energy Trust of Oregon's Efficient New Homes Program.* Prepared for the Energy Trust of Oregon. July 19, 2006.
- Schiller, Steven R. and Schiller Consulting, Inc. *National Action Plan for Energy Efficiency. Model Energy Efficiency Program Impact Evaluation Guide.* 2007. www.epa.gov/eeactionplan
- Northeast Energy Efficiency Partnerships, Inc. (NEEP). *The Need for and Approaches to Developing Common Protocols to Measure, Verify and Report Energy Efficiency Savings in the Northeast.* January 2006.
- Myers, Steve. *Accounting for Market Effects: What are states doing outside of California?* Prepared for the California Institute for Energy and Environment. May 23, 2008.

Appendix A summarizes key topics from previous residential new construction market effects studies in California and other states. The interview guide used for the investor-owned utility

(IOU) program managers and other IOU staff appears in Appendix B. The interview guide used for industry experts appears in Appendix C. The survey of non-participating homeowners (integrated with the NC/CS study) appears in Appendix D.

2 The Residential New Construction Market in California

2.1 Market Theory and Logic

Figure 1 below, labeled "The California Residential New Construction Market," reflects utility program staffs' and industry experts' views of the single-family, production new home market[4] in California, *as if the 2006-2008 utility programs did not exist*. On the left of the diagram is the mandatory, low-end side of the market and on the right is the more efficient side of the market, as stimulated by various voluntary activities. Within boxes in the diagram, bolded items are more important in the market than non-bolded items. Within some of the boxes are market actors—groups that participate in the market by fulfilling specific roles. Market actors vary according to the market being examined; in the RNC market, examples of market actors include home buyers, builders, subcontractors, manufacturers, distributors, designers, appraisers, lenders, Title 24 consultants, HERS raters, and local building code officials.

2.1.1 Requirements

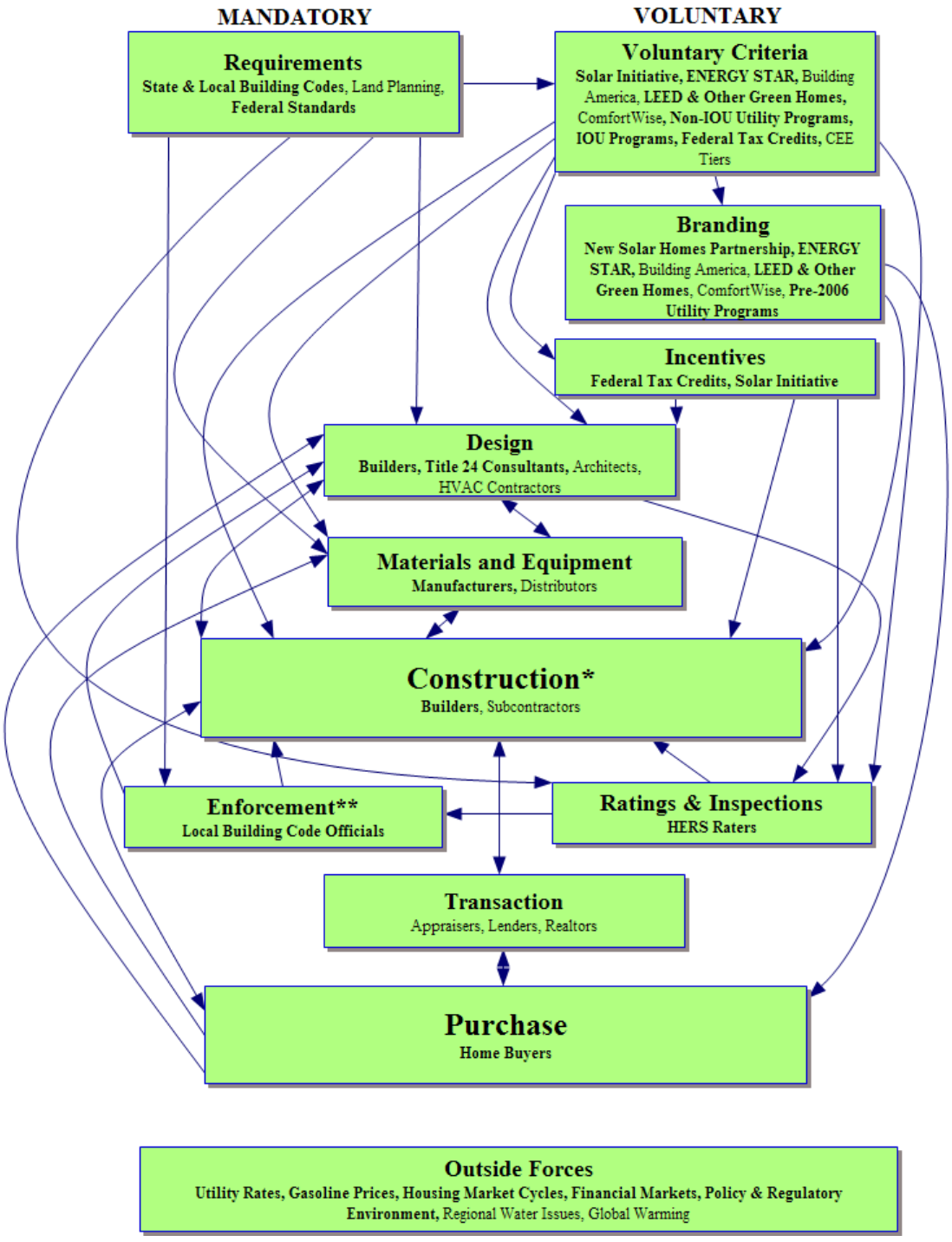
The minimal levels of efficiency in RNC are—at least in theory—determined by various government requirements:

- **Federal Standards.** While there are no federal standards for residential building codes at the state level, the federal government sets the minimum standard for many types of energy-using *equipment* that are available in the national marketplace; one example is 13 -Seasonal Energy Efficiency Ratio (SEER) central air conditioning, the lowest efficiency level allowed. If a product is covered by a Federal Energy Efficiency Standard, States and localities are preempted from enforcing a different Standard. In California, appliance and equipment energy efficiency standards are promulgated under Title 20. There is no Federal residential building energy efficiency code.
- **California State Building Code—Title 24.** Title 24, the current state building code, which became effective on October 1, 2005, includes three general approaches to compliance:
  - The ***prescriptive package approach*** is the simplest compliance approach, and simply requires a report submitted along with the building permit application showing conformity with Package D of the 2005 Building Energy Efficiency Standards. With this approach, the builder selects a package of insulation and window requirements from a list of packages developed for each of California's 16 climate zones. Each package specifies insulation levels, glazing areas, glazing U-Factors, duct sealing and insulation, and sometimes heating and cooling equipment efficiency. Once selected, the builder must

[4] Production homes account for about 85% of the market in California.

simply meet or exceed all requirements listed in the package to achieve compliance. This approach does not require calculation of a building's thermal performance. It is generally the most stringent of the three approaches.

Figure 1: The California Residential New Construction Market



- The ***trade-off approach*** enables the builder to trade off insulation and window efficiency levels in different parts of the building. In the trade-off approach, the report submitted for the building permit review process must not only include a statement of conformity with Package D, but also Package C—which specifies which of the pre-approved tradeoff measures are used to achieve Title 24 compliance. The builder can trade off ceiling, wall, floor, basement wall, slab-edge, and crawl space wall insulation; glazing and door areas; and glazing and door U-Factors. The trade-off approach calculates whether the home as a whole meets the overall code insulation and window requirements.

– The ***performance approach*** is more flexible than the prescriptive and trade-off compliance approaches, and through software modeling allows trade-offs between all building envelope components and heating and cooling equipment efficiencies. Under the performance approach, energy performance goals need to be achieved or exceeded (e.g., on a kBtu/ft^2/year basis with the actual value dependent on the reference house of comparison as defined by Package D in the 2005 Building Energy Efficiency Standards). Even under the performance approach, however, there are still mandatory minimum efficiency levels for specific measures, including insulation and Heating, Ventilating, and Air Conditioning (HVAC). Generally, production builders—those building subdivisions—opt for the performance approach because of the greater flexibility it allows in selecting building components. For the performance approach, Title 24 compliance is achieved by entering the building plans into a CEC-approved Title 24 software program, such as MICROPAS, and generating a passing report before applying for a building permit. The preparer of the Title 24 compliance report need not have any particular certification; however, the recently launched New Solar Homes Program does require that the Title 24 consultant hold a certification with the California Association of Building Energy Consultants (CABEC).

- **Local Building Codes.** Some municipalities, such as Davis and Roseville, have additional requirements for efficiency above Title 24.

- **Local and Regional Planning.** Local and regional planning poses more potential than actual requirements, and hence are not bolded in the market diagram, unlike the other requirements.

  – Regional planning could impact land use patterns and related energy efficiency issues, such as policies to encourage building on the coast where less heating and cooling are necessary than is the case in inland areas.

  – Local planning by municipalities could lay out new subdivisions to encourage efficiency, with streets aligned such that nearly all homes would have north-south orientations with narrower streets to provide more shade in order to enhance passive solar design and minimize cooling, and with smaller trees on one side of the street and taller trees on the other to encourage both shading and photovoltaics. According to at least one industry expert, these could be required through the California Environmental Quality Act (CEQA) and the Subdivision Map Act.[5]

[5] The Subdivision Map Act is one of the most basic and important statutes governing land use planning in California. (California Government Code Section: 66410-66499.)

Requirements affect voluntary criteria in that they determine the minimum threshold above which the voluntary criteria are set. Requirements also affect design, materials and equipment, enforcement, and voluntary ratings and inspection—which in turn affect construction.

2.1.2 Voluntary Criteria

There are several programs establishing voluntary energy efficiency criteria above code minimums:

- The Solar Initiative, encompassing the New Solar Homes Partnership, is promoted by the California Energy Commission (CEC), and ties incentives for photovoltaic systems (starting at $2.60 per watt for production homes and $2.50 per watt for other homes) with requirements for efficiency above Title 24—15% above Title 24 in the case of Tier 1, and 35% above Title 24 in the case of Tier 2. Both Tier 1 and Tier 2 require that all builder-provided appliances be ENERGY STAR-certified. The most common way to meet Tier 1 requirements is through increased insulation in the attic, more efficient windows, minimizing duct leakage, and improved cooling efficiency (such as going to a 15 SEER unit rather than the minimal level 13 SEER unit). The most common way to achieve Tier 2 requirements is through high-efficiency heating, high efficiency cooling (a 40% reduction in cooling energy use compared to Title 24 is required), quality insulation installation (QII), increased wall insulation (e.g., from R13 to R17 or R18), and high efficiency water heating. Both Tier 1 and Tier 2 efficiency levels, if they go through the Solar Initiative, are verified through solar-certified Home Energy Rating System (HERS) raters.
- A Federal Tax Credit of $2000 per home is provided to the builder for every home exceeding the 2004 International Energy Conservation Code (IECC) by at least 50%. This is about the same as exceeding Title 24 by 30%. The Federal Tax Credit does not give credit for water heater efficiency; if high-efficiency water heating is added in, the requirements for the Federal Tax Credit are about the same as those for Tier 2 (35% above Title 24).
- The ENERGY STAR Homes Program was initiated by the U.S. Environmental Protection Agency (EPA) to promote market adoption of higher levels of energy efficiency in new housing than required by building codes. To earn the ENERGY STAR designation, a home must be designed and built to be at least 15% more energy efficient than the energy code under which it was permitted; in California the applicable code is Title 24.[6] Any home three stories or less can earn the ENERGY STAR label if it has been verified to meet EPA's guidelines. ENERGY STAR homes can include a variety of energy-efficient features. These include effective insulation, high-performance windows, tight construction and ducts, efficient heating and cooling equipment, and efficient products (lighting fixtures, compact fluorescent bulbs, ventilation fans, and appliances). ENERGY STAR homes must be inspected by a certified third-party HERS rater. In addition, in California, ENERGY STAR homes must meet several other criteria. These are:

[6] Homes built under the 2001 T-24 code had until December 31, 2006 to complete construction. All homes completed on or after January 1, 2007 must be 15% more energy efficient than the 2005 T-24 code.

- Have verification of adherence to the California ENERGY STAR Homes combined QII and Thermal Bypass Checklist Procedures
- Utilize HVAC system sizing calculations that adhere to the latest editions of the Air Conditioning Contractors Association (ACCA) Manuals J and S, American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) 2001 Handbook of Fundamentals, or the equivalent computation procedure
- Have ductwork leakage less than 6 cubic feet per minute (CFM) to outdoors per 100 square feet of conditioned space (duct leakage tests can be waived if ducts and equipment are located in conditioned space and the home's envelope leakage is less than 0.25 CFM50 per square foot of building envelope).

Note that all of the additional requirements listed above can be utilized to achieve the 15% above-code performance margin.

The Thermal Bypass Checklist—a set of insulation-related requirements for achieving ENERGY STAR certification—is substantively similar to what is required under Title 24 and inspected by code officials. The inclusion of the Thermal Bypass Checklist in ENERGY STAR Homes necessitates additional inspection of the same items by a HERS rater. For this reason, many builders choose not to go the ENERGY STAR route.

- The U.S. Department of Energy's Building America program conducts building systems engineering research in how to make homes more energy-efficient in a cost-effective way. It works with interdisciplinary teams of architects, engineers, builders, equipment manufacturers, material suppliers, community planners, mortgage lenders, and contractor trades. All Building America homes meet ENERGY STAR standards and generally go into areas such as mechanics, ventilation, and onsite generation, the last of which is not usually covered by ENERGY STAR. Building America encourages builders to achieve high levels of efficiency, similar to the Tier 2 level of 35% above Title 24 requirements.
- There is a plethora of "green home" programs, with varying degrees of emphasis on efficiency.[7] One of these is the Leadership in Energy and Environmental Design (LEED) for Homes program from the U.S. Green Building Council, which was released in January of 2008 (it had existed before as a pilot). LEED for Homes provides certificates for new homes based on a point rating system for various green features, one of which is efficiency; to be certified, a home must meet ENERGY STAR specifications.
- The Environments for Living (EFL) Program[8] works with builders to certify homes at Silver, Gold, or Platinum levels. The energy (not cost) used for heating and cooling is guaranteed for two to three years; homeowners receive a refund if they use more energy. The program

[7] A review of online sources did not result in a lot of comparative program data across the numerous voluntary "green home" programs. Such research will be addressed in the proposed market effects study.

[8] Environments For Living program (www.eflhome.com) is a building science program sponsored by Masco Contractor Services (MCS), Inc., a subsidiary of Masco Corporation (NYSE: MAS). MCS is the largest insulation, fireplace and guttering contractor in the world. MCS is a member of the National Safety Council and the National Association of Home Builders.

provides training to builders, subcontractors, and sales organizations, mostly focusing on framing, duct sealing, air sealing, insulation, right-sizing HVAC systems, and ventilation. All Gold- and Platinum-level homes should also meet ENERGY STAR standards.

- A program that is unique to California is the ComfortWise program, run by ConSol, Inc. in cooperation with the California Building Industries Association (CBIA). ComfortWise encourages builders to build homes more efficiently than Title 24 requires. Prior to the current SBC funding period, SCE and SDG&E bought into ComfortWise as their implementation solution for the RNC market.
- While they do not operate in the investor-owned utilities' (IOUs') territories, programs run by other utilities can influence the market. For example, SMUD's RNC program has a Zero Net Energy Homes (ZEH) component in which homes are designed to use 60% less energy than required by Title 24; so far SMUD has more than 4,000 homes signed up, and expects it to encompass more than 30% of the market. SMUD now has a 75-unit pilot development with homes designed to achieve 80% savings compared to Title 24, and expects to increase the ZEH component to that level.
- Finally, the IOUs ran programs before 2006 that continue to influence the market. (The IOUs continue to have RNC programs, but this section attempts to describe the market in their absence.) These programs provided incentives for new homes exceeding the requirements of Title 24, including the 2001 version of Title 24, and for the last few months of 2005, the 2005 version of Title 24. Before the Thermal Bypass Checklist became part of the ENERGY STAR Homes specification, the California utilities' programs were substantially tied in with ENERGY STAR.

Voluntary criteria establish the basis for branding and incentives, and they affect design, materials and equipment, and construction.

2.1.3 Branding

Most of the voluntary criteria discussed above are associated with branding, which involves outreach to builders and in some cases outreach and advertising to homeowners, to get them to associate the name not only with the criteria themselves, but also with a set of benefits arising from these criteria, including lower operating costs, greater comfort, a healthier living environment, and a more durable home. Current brands of energy-efficient new homes include the New Solar Homes Partnership (through the Solar Initiative), ENERGY STAR Homes, Building America, LEED for Homes and various other "green" home brands, ComfortWise, and Environments for Living. Pre-2006 utility brands, which may still resonate in the market, included "Comfort Home"—later called the "Residential New Construction Program," offered by PG&E; SCG and SDG&E used the name "ComfortWise"[9] and then "Energy Advantage Program," which is now "Advanced Home" and SCE used the name "ComfortWise," and now uses the name "New Homes Program."

[9] As mentioned earlier, ConSol, Inc. continues to promote ComfortWise; earlier, ConSol licensed ComfortWise to SDG&E, SCG, and SCE as their implementation solution for the Residential New Construction (RNC) market.

Branding can affect purchasing if home buyers find the messaging persuasive. If builders think home buyers are responding to the brand, then builders will participate in the branding program; in this way branding can affect construction.

2.1.4 Incentives

The federal government, based on the Energy Policy Act of 2005, provides a tax credit of $2,000 to builders for each new energy-efficient home that achieves 50% energy savings for heating and cooling over the 2004 International Energy Conservation Code (IECC) and supplements. At least 20% of the energy savings must come from building envelope improvements. In California, the efficiency level required to get the tax credit is ENERGY STAR Tier 2, or 35% better than Title 24.

The California Energy Commission's (CEC's) Solar Initiative provides incentives starting at $2.60 per watt for production homes and $2.50 per watt for other homes. There is also a volumetric trigger, with the incentive declining 10% based on original incentive level when pre-specified target installed MW volumes are reached.

The incentives, then, are based on voluntary criteria, and they affect design and construction. Because payment of the Federal Tax Credit and the Solar Initiative incentives hinge on HERS ratings, the incentives also affect ratings and inspections.

2.1.5 Design

Market actors involved in the design of new homes as it affects energy efficiency include builders themselves,[10] Title 24 consultants, architects, one key design firm called ConSol, one key energy engineering firm called Davis Energy Group, and one key HVAC firm called Beutler Mechanical.

- Builders typically work interactively with Title 24 consultants to get their homes to achieve efficiency levels that will meet Title 24 requirements; as mentioned above under "Requirements," Title 24 requires a certificate of compliance. Most commonly, the role of the Title 24 consultants is to identify the least costly way to meet minimal code requirements, although in some cases they may help builders reach higher levels of efficiency—but again, usually in the least costly way. Builders are very cost conscious and their tendency is to repeat a "cookie-cutter design." But once they get a design approved for its efficiency—and once it starts being built—the design tends to be modified, which can affect the home's energy use. Title 24 consultants therefore continue to be involved with builders beyond design through the construction process so that a given home, after modifications to the original design, will meet Title 24 requirements. As one program manager said, "A lot of

[10] "Builders," as noted before, include production or merchant builders at about 85% of the market and custom builders making up the other 15%. Categories of employees at production builders include purchasing agents, site supervisors, executives, office staff, architects, engineers, carpenters, and various kinds of building specialists. Custom builders tend to be much smaller operations with more functions subcontracted out. The proposed study will explore the size and structure of the home builder industry in greater detail.

them are 'compliance jockeys' to 'beat Title 24' or 'get out of Title 24' rather than looking at a building and delivering recommendations for high-efficiency design."

- Most industry experts view architects as relatively unimportant in their effect on the efficiency of RNC. As one industry expert said, "Architects are surprisingly ineffective. They get consulted in the original design, which the builders modify as they see fit" as the design is used again in scores or hundreds of additional homes. One expert, however, dissented from this view, saying that architects probably decide on the efficiency of the home half the time, and builders the other half.
- ConSol is a significant and unique market actor because it runs the ComfortWise program (as mentioned above), runs Title 24 compliance software to determine what can and cannot be built under the code, and consults with the California Building Industries Association—a group to which many builders belong. Some industry experts say ConSol is very influential in deciding what can and cannot be built.
- Davis Energy Group has been at the forefront of advanced product and standards development in the California residential sector for some time. Davis Energy partnered with Building America (program of the US Department of Energy) to implement several emerging energy saving technologies. Davis Energy also partnered with Grupe Company, PowerLight, and Building America to develop the largest Zero Energy New Home community (144 homes in Carsten's Crossing) in the Sacramento area. In 2006, the USGBC introduced a pilot version of LEED for Homes—a voluntary rating system that promotes the design and construction of high-performance green homes. For the LEED for Homes Pilot Program, Davis Energy Group (DEG) was chosen by the United States Green Building Council (USGBC) as a provider in California and Nevada, and over 50 builders have joined DEG in the Pilot Program.
- Beutler Mechanical is another prominent and unique market actor. Among HVAC contractors, Beutler has unparalleled volume, market share, and geographic concentration. It has around 80% share of the new home HVAC market within SMUD territory, nearly as much in Roseville, and around 30%-35% in Stockton and the San Francisco Bay Area. Beutler has been responsible for recruiting builders accounting for more than 90% of homes participating in SMUD's program; it makes builders aware of programs and tries to make the programs work financially for builders. Beutler does design-build engineering including Title 24 consulting, and uses its volume purchase power to get better prices from manufacturers—not just for HVAC equipment, but also for other materials such as windows. Beutler has also recently become a manufacturer as well, making a water-cooled air conditioning system called AquaCool, which is super-high efficient even at high temperatures. SMUD recently installed 30 AquaCool systems as part of a pilot program, and if it works will add it to the SMUD program.

Design is limited by the materials and equipment that are available, but through specification of materials and equipment also affects their availability and cost. Design obviously affects construction, but construction—through feedback on what works well and doesn't work well—also affects design; that is why builders appear as market actors in the diagram under both design and construction activities. Design is also affected by requirements and their enforcement, voluntary criteria, incentives, and consumer preferences.

2.1.6 Materials and Equipment

Manufacturers are responsible for the efficiency of materials and equipment available for use in new homes, and distributors are a conduit—although large builders or subcontractors may deal directly with manufacturers. There are also minimum standards that manufacturers must adhere to and voluntary specifications they may aspire to. Federal standards, and sometimes Title 24 and local building code requirements, provide the floor for efficiency standards for many types of equipment and materials installed in new homes, including air conditioning, furnaces, appliances, and windows.

- On the voluntary side, there are ENERGY STAR specifications for more efficient equipment (in addition to more efficient new homes), including air conditioning, furnaces, appliances, windows, and lighting.
- The Consortium for Energy Efficiency (CEE) has defined tiers of efficiency above ENERGY STAR levels for central air conditioning/heat pumps and appliances.

Materials and equipment are affected by requirements and voluntary criteria. The efficiency of the design and construction of a home is also limited by the efficiency of the materials and equipment that are available; the availability and cost of materials and equipment are in turn affected by their specification in design and their use in construction. Finally, materials and equipment can be affected by consumer preferences.

2.1.7 Construction

By definition, construction is one of the two central activities in the new home market, and builders are the one of the two key market actor groups (with the other key activity being purchasing and the other key market actor group being home buyers). Most builders are motivated by costs and profits; because they will not be paying the utility bills for the homes they build, they are not motivated to increase the homes' efficiency unless they can recover (or more than recover) the extra cost, or increase their share of the new construction market. Ultimately, if a home is to be built at efficiency levels above Title 24, builders make most of the construction decisions.

Program managers and other industry experts routinely state that production builders account for more than 85% of the market. Those who were interviewed, however, were divided as to whether the leaders in efficiency in new construction are most often production builders or custom builders. The experts who say production builders are efficiency leaders say that the cost of analysis is a high percentage of the cost of one home, but that for spec-built homes it can be spread over many homes. For example, it may cost $1,000 for analysis for one home, and $4,000 if the analysis is packaged for multiple homes. (This is in addition to costs for equipment upgrades, which could, for example, amount to $2,000 per home.) A builder who builds 100 homes with the same design spreads the $4,000 over 100 homes, and if the effort is successful, may use the same design on an additional 500 or 1,000 homes. Economies of scale, then, are key.

Other experts, however, say that innovation in efficiency probably happens most commonly with custom homes. Production builders may look to custom builders for examples of new technologies to use, such as foam integrated concrete walls. Their successful example would be persuasive with skeptical production builders.

Particular builders whom others follow as examples of efficiency, according to experts, include D.R. Horton, Grupe Company, Pulte and SCM Homes. One expert mentioned Premier Gardens as a development that provided an example to many builders (built by Premier Homes in collaboration with Building America, SMUD, National Renewable Energy Laboratory (NREL), and ConSol). Premier Gardens is said to be well known in ZEH circles and served as the model for SMUD's Solar Smart program.

Within production builder organizations, two key actor groups who can influence efficiency are purchasing agents and field supervisors/job superintendents. Purchasing agents make buying decisions for builders, affecting multiple subdivisions. They are driven primarily by cost—"nickel and dime savings on water heaters or blown vs. batt insulation."

Field supervisors or job superintendents are responsible for work on day-to-day basis, catching any problems in installations. They are decision makers in a limited sense in that sometimes they put in equipment that is less efficient than specified if it meets code, and that they can stop a quality installation if it slows down their work.

Being at the center of the new construction process—as indicated by the word itself—construction is linked with every other activity depicted in the market diagram. Most directly, though, construction is affected by design, materials and equipment, enforcement of code, ratings and inspections to assess achievement of voluntary criteria, incentives for achieving those criteria, branding of those criteria through builder recruitment, and consumer responses to homes that are built—both directly and as mediated by appraisers, lenders, and realtors. Construction activity affects design as well materials and equipment through feedback about what does and does not work, and affects purchases and transactions by making houses available for sale.

2.1.8 Enforcement

Local building officials are charged with enforcing the Title 24 requirements developed at the state level, and occasionally additional requirements developed at the local level. According to industry experts, code enforcement is uneven across municipalities, and one PG&E study in 2002 showed overall compliance at 71% with considerable variation across climate zones.[11]

Enforcement is affected by the requirements that code officials are meant to enforce, and by ratings and inspections (see below). Enforcement primarily affects design and construction.

[11] *Residential New Construction Study (Project Year 2)*, Prepared for PG&E by RER (Sept. 26, 2002).

2.1.9 Ratings and Inspections

Home Energy Rating System (HERS) raters, who provide field verification of new homes' energy efficiency, are central to the national ENERGY STAR program because meeting a minimal HERS score is required for certification. HERS ratings are also required for builders receiving the federal tax credit, for receiving Tier 2 solar incentives under the Solar Initiative, and LEED certification. Also, under Title 24 requirements, a HERS rater's QII verification can earn energy credits within Title 24, and the verification is sometimes cheaper than other ways of getting points. According to industry experts, builders perceive the credits to have the added value of helping them to avoid callbacks and lawsuits by providing an extra seal of approval and insurance. California Home Energy Efficiency Rating Service (CHEERS) trains and certifies HERS raters, provides ongoing quality control, and maintains an online registry of raters; HERS raters do not work for CHEERS, but rather are independent.

Ratings and inspections, then, are affected by Title 24 requirements, voluntary criteria, design, and incentives. In turn, ratings and inspections affect construction and enforcement.

2.1.10 Transaction

Appraisers, lenders, and realtors are typically intermediaries in transactions between production builders and the home buyers. According to industry experts, realtors have very little influence on the efficiency of new homes—they simply respond to what they think home buyers want to hear. Appraisers have the potential to affect efficiency insofar as they assign value to it—which could help builders recoup their investments in it—but the extent to which this has happened is open to question. Lenders, too, can affect efficiency by offering energy efficient mortgages (EEMs) and thus helping home buyers afford the extra upfront costs for efficiency, although not all lenders do so. A 2000 study conducted for PG&E estimated that there were more than 2,000 EEMs in California in 1999 with the vast majority being issued in PG&E service territory; however, that number declined considerably during the year 2000.[12]

2.1.11 Purchase

Home buyers are central actors in the RNC market—and the reason for its existence. Buyers of custom homes—a small part of the market—can be involved in design and the choice of materials and equipment. Buyers of production homes—more than 85% of the market—may buy completed homes, may be given some limited choices of certain materials and equipment from a list compiled by the builder, or may be given a budget for certain items that they may select themselves. Buyers' responses, though, provide feedback to design, materials and equipment, and construction, and can affect what is later offered to others.

---

[12] *2000 Market Effects Study of the TOSER EEM Program –Updated Final Report*, Prepared for PG&E by XENERGY (March 1, 2001).

Home buyers, through demand, have the power to drive the market. The intent of the various brands mentioned above is to get home buyers to drive the market toward greater efficiency. Efficiency competes with many other consumer demands, though, including the location of the home, its size and layout, and granite countertops and other amenities. The cost of greater efficiency as it competes with other features of the home, then, is a central barrier. Another barrier is the lack of a price signal in energy consumption, such that consumers cannot see the direct impact of their behavior. There is also lack of awareness of cost savings through greater efficiency. There is a lack of perception of value because energy efficiency features are not visible, and do not affect the appearance of the home—they're "reassuring but not sexy"; this is in contrast to photovoltaic panels, which clearly are visible and are becoming increasingly desirable. A final barrier is the lack of a central brand, and a proliferation of labels connoting increased efficiency.

Demand-side drivers for greater efficiency include cost savings and improved cash flow, once consumers are aware of them. Many industry experts interviewed for this work said that higher gasoline prices were a major driver for increased efficiency—not just for cars, but for efficiency in general—because their high visibility increases this awareness. The visibility of photovoltaic panels, as mentioned above, is a driver—at least now that they are seen as desirable. Their desirability derives in part from an increasing "green sensibility"—a desire to "do the right thing" in relation to global warming and to live sustainably. Finally, improved health and comfort, insofar as home buyers perceive them as benefits, can be drivers for greater efficiency in new home construction.

2.1.12 Outside Forces

The California RNC market does not operate in a vacuum; various outside forces can affect its direction. For example, changes in utility rates can affect the savings potential of efficiency improvements and in turn consumers' reactions. Gasoline prices, as mentioned earlier, can affect home buyers' awareness of efficiency. Awareness of global warming can make consumers more willing to pay for efficiency, although some market actors say the effect is limited. The ups and now the downs of the housing market can affect prices and competition among builders. There was near universal agreement among market actors interviewed for this study that the effect of the building boom was to minimize unit efficiency because nearly any home could sell, and there was an issue of quality control because of turnover in subcontractor staffs; however, in the current housing downturn, there was widespread agreement that builders are using increased efficiency as a way to differentiate, hold on to market share, and minimize price reductions. In particular, photovoltaics appear to be gaining greater traction as a way to differentiate in the current market downturn.

2.2 Summary of Market Drivers and Barriers

Table 1 summarizes market drivers and barriers for builders/subcontractors and home buyers.[13] This is a preliminary list and will be expanded later during the Phase 1 study

Table 1: Summary of Market Drivers and Barriers

Market Actor	Driver	Barrier
Builders and subcontractors	Perception of consumer demand*	Lack of perception of demand; ability to sell homes whether or not they have efficient features*
	The ability to spread costs over multiple homes—economies of scale	Organizational practices and custom—e.g., purchasing agents' focus on "nickels and dimes" in equipment purchase decisions
	Increasing "green sensibility" among consumers	Hassle or transaction costs—e.g., field supervisors' ability to stop quality installation if it slows down their work
	Seeing other builders able to sell homes with new efficient techniques & technologies	Information costs—lack of familiarity with efficient technology, exacerbated by staff turnover
	Builders selecting HVAC contractors on service and reliability to avoid callbacks*	Hidden costs—e.g., fear of callbacks and lawsuits*
	"Green" construction making local permits easier to obtain	Lack of awareness and knowledge about energy efficient techniques and technologies, including staff turnover
Home buyers	Cost savings and improved cash flow*	Lack of awareness of cost savings, and lack of a price signal when using utility-delivered energy*
	Higher price signal for gasoline at the pump	Cost of efficiency competing with other home features
	Increasing "green sensibility"	Information costs
	Visibility of photovoltaic panels*	Lack of visibility of efficiency; not affecting appearance of home*
	Other efficiency branding efforts*	Lack of a central brand*

[13] For a complete discussion of barriers to energy efficiency market transformation programs in general, see Eto, Joseph, Ralph Prahl, and Jeff Schlegel, *A Scoping Study on Energy Efficiency Market Transformation by California Utility DSM Programs.* Berkeley, CA: Lawrence Berkeley National Laboratory, prepared for the California Demand-Side Measurement Advisory Committee, July 1996. The above barriers also derive from a list specific to residential new construction sent by Robert Kasman of PG&E.

	Non-energy benefits, such as improved health, comfort, and home durability*	Lack of awareness of non-energy benefits*
	Lenders offering more favorable terms for efficient homes*	Limited offers for "energy efficient" mortgages*
	Appraisers taking energy efficiency into account when valuing homes*	Appraisers not valuing energy efficiency in homes*
		Performance uncertainties—lack of certainty about savings and other benefits*
		Asymmetric information
		Hassle or transaction costs
		Bounded rationality—information overload

* Drivers related to any adjacent barriers are both marked with asterisks

3 The California Utilities' Residential New Construction Programs

Table 2 provides brief descriptions of the utilities' programs under consideration.

Table 2: IOU Residential New Construction Program Descriptions

Program	Name	Implementer	Description	Type	Target Market	Key Market Actors	Delivery Strategy
PG&E 2009	Residential New Construction	PG&E (see 2059 for multi-family component)	PG&E's RNC Program is a portfolio of products and services designed to encourage high performance building design that exceeds the 2005 California Energy Efficiency Standards in overall performance design by 15% or more and enhance the adoption of energy efficient equipment and practices among the single and multi-family building industry. The program also aims to increase the adoption and installation of individual high efficiency measures, such as efficient heating, cooling, lighting, and appliances in RNC.	PG&E's performance-based program incentives are based on the CEC climate zone in which the project is constructed and the construction type. Measure incentives are also based on the construction type, and not all measures are rebated for all building types.	Single-family detached and attached, site built	The program targets all residential builders regardless of production size, market segment or geographic location, all will be presented to builders, developers, energy analysts, HERS raters, and other building industry professionals. Additional attention will be focused on customers who typically do not have easy access to program information and do not generally participate in energy efficiency programs for a variety of reasons.	The single family portion of PG&E's new construction program is implemented through direct contact with builders, developers, energy analysts, and building trade professionals.

Program	Name	Implementer	Description	Type	Target Market	Key Market Actors	Delivery Strategy
SCE 2505	New Homes	ICF for single-family; HMG for multi-family	SCE's California New Homes Program is a portfolio of products and services designed to encourage high performance building design that exceeds the 2005 California Energy Efficiency Standards in overall performance design by 15% or more and enhance the adoption of energy efficient equipment and practices among the single and multi-family building industry. The program also aims to increase the adoption and installation of individual high efficiency measures, such as efficient heating, cooling, lighting, and appliances in RNC.	SCE's performance-based program incentives are based on the CEC climate zone in which the project is constructed and the construction type. Measure incentives are also based on the construction type.	Single-family detached and attached, low-rise multi-family	The program targets all residential builders regardless of production size, market segment or geographic location, all will be presented to builders, developers, energy analysts, HERS raters, and other building industry professionals. Additional attention will be focused on customers who typically do not have easy access to program information and do not generally participate in energy efficiency programs for a variety of reasons.	ICF, a global professional services firm, is responsible for the single family portion of the New Homes Program. They are responsible for promoting the program among HERS raters, who will, in turn, promote the program among builders, emphasizing the distinguishing nature of an energy efficient home. HMG is responsible for the multi-family portion of the New Homes Program. They will provide design assistance to low- and high-rise multi-family home builders, and will focus on promoting the program with their contacts in the affordable housing market, through venues such as trade shows.

Program	Name	Implementer	Description	Type	Target Market	Key Market Actors	Delivery Strategy
SDG&E 3007	Advanced Home	SDG&E	SDG&E's Advance Home Program is a portfolio of products and services designed to increase the adoption of energy efficient equipment and practices, sustainable design and construction, green building practices, and emerging technologies in the single and multi-family building industry. The program provides support to encourage high performance building design that exceeds the 2005 California Energy Efficiency Standards in overall performance design by 15% or more, while also promoting individual high efficiency measures in heating, cooling, and water heating design and installation in RNC.	SDG&E's performance-based program incentives are based on the CEC climate zone in which the project is constructed and the construction type. Measure incentives are also based on the construction type.	Single-family, low-rise and high-rise multi-family; custom homes, single-family production housing, condominiums, town homes and rental apartments	The program targets the residential design and construction team; architects, energy analysts, HERS raters, trade contractors, and builders. The market segment is low-rise (3 or fewer stories) RNC with participation open to all RNC including custom homes, single family production housing, town homes, and low-rise condominiums and rental apartments.	SDG&E's program is implemented through direct contact with market actors: architects, mechanical engineers, energy analysts, HERS) providers, HERS raters and the building industry. The program provides design assistance, education, and training to these actors and evaluates projects for the most suitable approach to increasing energy savings.

Program	Name	Implementer	Description	Type	Target Market	Key Market Actors	Delivery Strategy
SCG 3502	Advanced Home	SCG	SoCalGas' Advance Home Program is a portfolio of products and services designed to increase the adoption of energy efficient equipment and practices, sustainable design and construction, green building practices, and emerging technologies. The program provides support to encourage high performance building design that exceeds the 2005 California Energy Efficiency Standards in overall performance design by 15% or more, while also promoting individual high efficiency measures in heating, cooling, and water heating design and installation.	SoCalGas' performance-based program incentives are based on the CEC climate zone in which the project is constructed and the construction type. Measure incentives are also based on the construction type.	Single-family, low-rise and high-rise multi-family; custom homes, single-family production housing, condominiums, town homes and rental apartments	The program targets the residential design and construction team; architects, energy analysts, HERS raters, trade contractors, and builders. The market segment is low-rise (3 or fewer stories) RNC with participation open to all RNC including custom homes, single family production housing, town homes, and low-rise condominiums and rental apartments.	SoCalGas' program is implemented through direct contact with market actors: architects, mechanical engineers, energy analysts, HERS providers, HERS raters and the building industry. The program provides design assistance, education, and training to these actors and evaluates projects for the most suitable approach to increasing energy savings.
PG&E 2011 SDG&E 3004 SCE 2516 SCG 3501	Statewide Codes & Standards	PG&E, SDG&E, SCE, SCG (jointly-administered)	Promotes energy efficiency upgrades to codes and standards; transitioning from education to resource acquisition. Enhance state and federal appliance and building codes including Title 20 and 24.	Information, education	Residential and non-RNC and appliances	(1) All stakeholders interested in making improvements to the energy code, and (2) Local code compliance officials, building officials and other entities involved in the implementation of the energy efficiency standards	The overall strategy is to provide information that is consistent with the pubic rulemaking process and setting. Initial information is provided though development of CASE studies that are presented to the CEC and docketed for reference. Continuous support is required to sustain CEC efforts to mediate differences between proponents of changes such as IOUs and those with different interests (usually industry groups).

Figure 2, labeled "Utility-Run/CPUC-Approved RNC Programs" reflects utility program staffs' and industry experts' descriptions of the IOUs' RNC programs. On the left side, under "Program Elements," in diamond-shaped boxes, are the key elements of the utility programs. To the right of the elements, in oval-shaped boxes, are short-, medium-, long-term outcomes that the utilities expect to occur as a result of their activities.

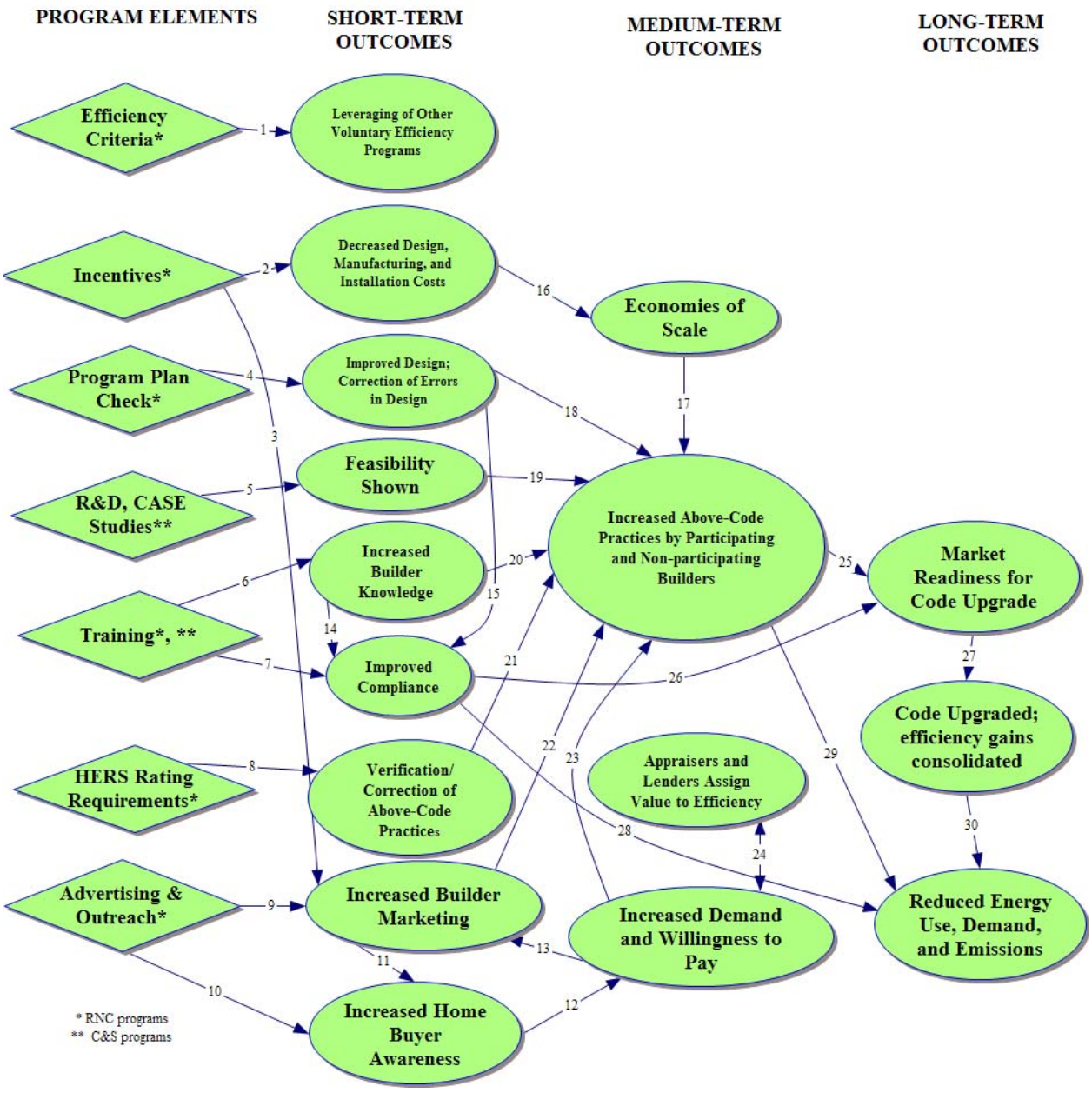
Figure 3, labeled "Utility Programs in Relation to the Residential New Construction Market," shows utility program staffs' and industry experts' views of how the programs are designed to affect the single-family, production new home market in California. The left side of Figure 3 is the same as in the market diagram in Figure 1, and the right side is the same as the program diagram in Figure 2. Figure 3 links the two sides to show how the programs are meant to affect the market, working through the market as it exists.

The key program elements, as depicted in Figure 3, are efficiency criteria, incentives for meeting those criteria, research and development, case studies, training, and advertising and outreach. The positioning of these elements next to the market activities indicates that the programs are meant to feed into and leverage activities and relationships that already exist in the market.

- Efficiency Criteria
  - PG&E's Residential New Construction Program, SCE's New Homes Program, and SDG&E's and SCG's Advantage Home Program are tied to the Tier 1 (15% above Title 24) and Tier 2 (35% above Title 24) criteria described above under "Voluntary Criteria." Since the introduction of the Thermal Bypass Checklist to the ENERGY STAR Homes program, the utilities no longer promote ENERGY STAR, but have their own program names added to the plethora of program names outlined above.
  - PG&E's Duct & Cover Program, administered by ConSol, provides incentives for achieving 20% greater efficiency than required by Title 24, with several mandatory HERS measures including Quality Insulation Installation (QII), an infiltration test, 11 EER[14] minimum central air conditioning, buried ducts, and verified system airflow.
  - For homes in gas utilities' territories but in municipal electric companies' territories, the gas utilities' programs have incentives for furnaces with minimum 92% Annual Fuel Utilization Efficiency (AFUE), and for tankless water heaters. These are measure-specific incentives and are not tied to Title 24.

[14] EER (Energy Efficiency Ratio) differs from SEER (Seasonal Energy Efficiency Ratio) in that the latter is a measure of efficiency at 82 degrees outside and 80 degrees inside, while EER measures system efficiency nearer to peak temperatures (for example, 95 degrees with EER95).

Figure 2: Utility-Run/CPUC-Approved RNC Programs



- Incentives. The utilities provide incentives for meeting all of the above criteria. In the case of Tier 1 and Tier 2 criteria, homes with certified photovoltaic systems are also eligible for the state's Solar Initiative incentive. A builder whose home meets Tier 2 criteria is also likely to be eligible for the Federal Tax Credit. The expected outcomes of the incentives—reinforcing criteria already existing in the marketplace—are to decrease the extra cost for higher levels of efficiency, thus leading to more acceptance from builders and also greater economies of scale.

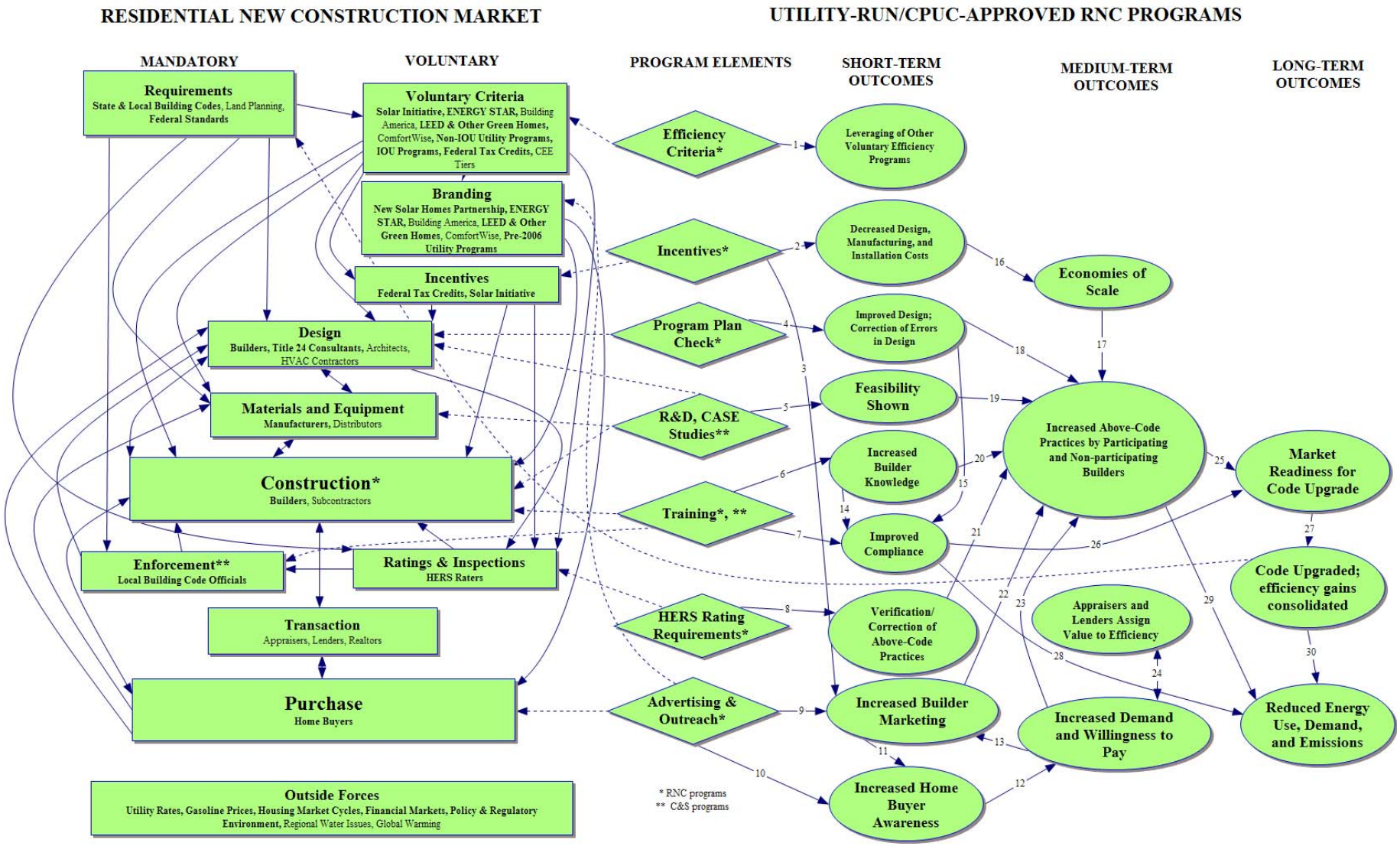
An example of how this worked in the past was PG&E's 1993 program promoting 16 SEER central air conditioning, 94% AFUE furnaces, and "green" glass (before the time of "low e" glass). At that time there was only one central AC manufacturer that made 16 SEER units. PG&E researched the cost, and it was $5,000 extra to install, so the rebate was figured at 80% of that, or $4,000. Because builders were "eating" the $1,000, it was a tough sell, and very little happened. Then one key market actor went to the manufacturer, and said they could sell 1,000 16-SEER units if the price came down—and at the time the manufacturer only sold about 1,000 units per year in the whole country. So the manufacturer brought the price down from $2,500 to $1,800. Meanwhile, the key market actor also talked with some window manufacturers, who because of assurances of volume brought the cost of "green" glass (before "low e" glass was defined) down from $2 to $1 per square foot. Then the cost of the upgrade became $3,200, with a $4,000 rebate, and the builders were actually making more money. "It went like hotcakes," but then PG&E refigured the rebate to be 80% of the new incremental costs, and it slowed back down. Even so, it does provide an example of how incentives can lead first to decreased costs and then to economies of scale. The incentives also lead to an increase in builders' own marketing of efficiency.

- Program Plan Check. Program Plan Check corrects modeling errors by Title 24 consultants. The feedback indirectly educates Title 24 consultants on correct practice.
- Research & Development (R&D) and Case Studies. As part of their Codes & Standards programs, the utilities perform research and development of emerging technologies and provide demonstration through case studies. The R&D and case studies show that new techniques working with new technologies can be feasible.
- Training. The utilities provide training for builders in new techniques of construction working with new technologies (part of the RNC programs), and PG&E (not the other utilities) provides training for building code officials in how to inspect for purposes of code enforcement (part of PG&E's Codes & Standards program). The training for participating builders increases their knowledge, and the training for building code officials increases enforcement of Title 24 requirements, primarily among non-participating builders. One market actor who specializes in training local building department officials in code enforcement has framed on his wall a building inspection "fail" notice for inadequate insulation, which he says is happening more and more now, and would not have happened without PG&E's training.
- HERS Rating Requirements. HERS ratings to verify proper installation and specified equipment are required for a home to achieve Tier 1 or Tier 2 efficiency levels. This assures that the efficiency levels achieved match the incentives paid.
- Advertising and Outreach. The utilities advertise their "brands" and the associated benefits, which increases home buyer awareness of efficiency. Along with incentives, the advertising and outreach encourages the builders' own marketing in order to associate themselves with the brand and differentiate themselves from competitors; the builders' own marketing, in turn, contributes to consumer awareness. In time, increased awareness leads to increased demand, which feeds more builder marketing as builders perceive this demand.

Eventually, increased consumer demand, along with economies of scale, demonstrates feasibility, and increased builder knowledge leads to conditions in which the practices the utility is promoting are adopted by a significant minority or even a majority of builders. This means the practices are realistically within the capabilities of builders to achieve, and that the market is ready for a code upgrade. This market readiness contributes to the code being upgraded, which in turn feeds back to the mandatory side of the market and provides a new efficiency floor against which new voluntary criteria can be established. Hence the utilities' programs can be viewed as part of the market, not simply as an addition to it.

The three ways the IOU's programs lead to the ultimate goal of reduced energy use, demand, and emissions are through improved enforcement of existing code, facilitation of construction that is more efficient than required by the current code, and making the market ready for code upgrades.

Figure 3: Utility Programs in Relation to the Residential New Construction Market



3.1 Indicators of Expected Outcomes

The key elements of the IOU's RNC programs are efficiency criteria, incentives for meeting those criteria, research and development, case studies, training, and advertising and outreach. The positioning of these elements next to the market elements in Figure 3 indicates that the programs are meant to feed into and leverage activities and relationships that already exist in the market. The links in Table 3 correspond to the numbered arrows in Figure 2 and Figure 3. Please note that there can be more than one indicator of an expected outcome, just as different outcomes can be associated with a single indicator.

Table 3: Logic Model Links, Theory, and Indicators

Link	Program Theory and Indicators
1	**Program Theory** IOU programs leverage other voluntary efficiency programs **Measurable Indicators** Managers of other efficiency programs say that some of their efficiency criteria are based on the IOU program criteria; Managers of other efficiency programs say the IOU programs increase participation in their programs
2	**Program Theory** IOU incentives for builders, leveraging other available incentives, decrease the cost of increased efficiency **Measurable Indicators** Participating builders report that the IOU incentives combined with other incentives have significantly decreased the incremental cost of increased efficiency; Manufacturers report that the IOU incentives combined with other incentives have significantly decreased incremental costs for efficient technologies
3	**Program Theory** IOU incentives for builders induce them to increase their marketing of efficiency **Measurable Indicators** Participating builders report increasing their marketing of efficiency because of IOU programs and incentives; Number of participating builder ads and signs mentioning efficiency increases
4	**Program Theory** Program Plan Check catches and corrects modeling errors on participating homes. The feedback educates Title 24 consultants, which improves the modeling of existing homes. **Measurable Indicators** Title 24 consultants say Program Plan Check catches modeling errors on participating homes; Title 24 consultants say Program Plan Check has helped improve their modeling of non-participating homes

5	**Program Theory** IOUs' research & development of new technologies and practices and case studies on their deployment show builders that the new technologies and practices are feasible **Measurable Indicators** Many participating builders and some non-participating builders are aware of the proven practicality of using the new technologies and practices
6	**Program Theory** Training of participating builders in new technologies and practices leads to increased builder knowledge **Measurable Indicators** Many participating builders and their subcontractors—and through subcontractors, some non-participating builders—become more knowledgeable of new technologies and practices
7	**Program Theory** Training of code officials leads to improved enforcement of the building code **Measurable Indicators** Rate of compliance shown in evaluators' onsite inspections increases; The incidence of compliance is higher in municipalities whose code officials have received PG&E-sponsored compliance training
8	**Program Theory** HERS rating requirements for program participation ensure that above-code practices promoted through the program are implemented in participating homes **Measurable Indicators** On-site inspections of participating homes shows that above-code practices are implemented
9	**Program Theory** IOUs' advertising and outreach causes builders to increase their own marketing of efficiency **Measurable Indicators** Many participating builders market energy efficiency as a feature of their homes; Number of builder ads and signs mentioning efficiency increases
10	**Program Theory** IOUs' advertising and outreach increases home buyers' awareness of energy efficiency and associated benefits including cost savings, comfort, health, and home durability **Measurable Indicators** Participating home buyers and non-participating home buyers become more aware of energy efficiency as an important feature of new homes, hearing about it from IOUs' advertising and outreach

11	**Program Theory** Builders' marketing increases home buyers' awareness of energy efficiency and associated benefits including cost savings, comfort, health, and home durability **Measurable Indicators** Participating home buyers and non-participating home buyers become more aware of energy efficiency as an important feature of new homes, hearing about it from builders
12	**Program Theory** Increased home buyer awareness causes an increase in home buyer demand for energy efficiency and an increase in willingness to pay **Measurable Indicators** Participating home buyers and non-participating home buyers ask builders about the efficiency of homes; they rank efficiency more highly on lists of desired home attributes; and they express greater willingness to pay the incremental costs
13	**Program Theory** Increased home buyer demand for energy efficiency causes an increase in builder marketing of efficiency **Measurable Indicators** Participating builders and non-participating builders perceive an increase in home buyer demand for efficiency and therefore increase their marketing of it; Number of builder ads and signs mentioning efficiency increases
14	**Program Theory** Increased non-participating builder knowledge leads to greater code compliance **Measurable Indicators** Non-participating builders as well as local building code officials say program training has helped improve code compliance
15	**Program Theory** Improved design and correction of errors through Program Plan Check leads to improved compliance **Measurable Indicators** Title 24 consultants say that Program Plan Check has helped them learn more about modeling and improved the compliance of non-participating homes
16	**Program Theory** The decreased cost of energy-efficient technologies and practices encourages economies of scale and helps decrease their incremental cost beyond the amount of the incentive **Measurable Indicators** Manufacturers and builders report decreases over time in the incremental costs of energy-efficient technologies and practices, beyond the amounts of IOU incentives

17	**Program Theory** Increased economies of scale for energy-efficient technologies and practices leads to their adoption by an increasing number of builders **Measurable Indicators** Some participating builders and a few non-participating builders report decreasing incremental costs of energy-efficient technologies and practices as a factor encouraging their use; The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time
18	**Program Theory** Improved design leads to increased above-code practices among participating and non-participating builders **Measurable Indicators** Title 24 consultants say that Program Plan Check has helped them learn more about modeling and improved above-code design of participating and non-participating homes; The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time
19	**Program Theory** The demonstration of feasibility of energy-efficient technologies and practices leads to their adoption by an increasing number of builders **Measurable Indicators** Participating builders and non-participating builders who are aware of the IOUs' R&D and case studies are more likely than others to try the new technologies and practices; The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time
20	**Program Theory** Increased knowledge about energy-efficient technologies and practices leads to their adoption by an increasing number of builders **Measurable Indicators** Some participating builders and a few non-participating builders who became knowledgeable about new energy-efficient technologies and practices (directly or indirectly) through the IOUs' training are more likely than others to try the new technologies and practices; The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time
21	**Program Theory** Verification of above-code practices by Program Plan Check provides feedback to designers and builders which makes achieving program requirements easier as time goes on **Measurable Indicators** Participating and non-participating builders and Title 24 consultants say modeling and building above code becomes easier over time because of feedback from Program Plan Check; Above-code practices observed in on-site inspections increase over time

22	**Program Theory** Increased builder marketing of efficiency by some builders leads other builders to adopt energy-efficient technologies and practices **Measurable Indicators** Non-participating builders who are aware of increased marketing of efficiency by other builders are more likely than others to try the new technologies and practices; The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time
23	**Program Theory** Increased demand from home buyers for energy-efficient technologies and practices leads to their adoption by an increasing number of builders **Measurable Indicators** Some participating builders and a few non-participating builders report increasing home buyer demand for energy-efficient technologies and practices as a factor encouraging their use; The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time
24	**Program Theory** Increased home buyer demand for energy efficiency causes appraisers to assign value to efficiency and lenders to provide energy efficient mortgages (EEMs), which in turn increases home buyer demand **Measurable Indicators** Appraisers and lenders perceive an increase in home buyer demand for efficiency and, respectively, assign more value to it and make more EEMs available; Home buyers are aware of appraisers assigning value to efficiency and lenders providing EEMs, which increases home buyer demand
25	**Program Theory** Enough builders are using energy-efficient technologies and practices such that the market is prepared for a code upgrade **Measurable Indicators** The incidence of energy-efficient technologies and practices, as observed in evaluators' on-site inspections of participating and non-participating homes, becomes a significant part of the market; Key builders and industry experts indicate that there is enough knowledge and availability of efficient technologies and practices in the marketplace that the code could be upgraded and most builders could comply within a reasonable time

26	**Program Theory** Improved compliance with the current code improves the least efficient end of the market and helps prepare the market for a code upgrade **Measurable Indicators** The incidence of code-compliant homes increases over time as observed in evaluators' on-site inspections; the incidence of compliance is higher in municipalities whose code officials have received PG&E-sponsored compliance training
27	**Program Theory** The market proves ready and the code is upgraded **Measurable Indicators** Key builders and industry experts indicate that the IOUs' programs have contributed to market readiness for a code upgrade that has occurred or is planned, thus consolidating and ensuring the sustainability of efficiency gains; Utility measures incentivized in the 2006-2008 programs are part of the 2008 code, or are in the draft language of the 2011 code.
28	**Program Theory** Improved compliance with existing code leads to reduced energy use, demand, and emissions **Measurable Indicators** Energy use and associated emissions as well as demand in non-participant homes are lower than in the baseline case without code enforcement training
29	**Program Theory** Increased use of energy-efficient technologies and practices in non-participant homes, above the current code, leads to reduced energy use, demand, and emissions **Measurable Indicators** Energy use and associated emissions as well as demand in non-participant homes are lower than in the baseline, non-program case
30	**Program Theory** An upgrade in the building code leads to reduced energy use, demand, and emissions **Measurable Indicators** Energy use and associated emissions as well as demand in non-participant homes are lower than in the baseline case without a code upgrade

3.2 Other Factors Affecting RNC Energy Efficiency

The above program theory explicates the expected outcomes of program activity and indicators to measure those outcomes. Attributing the observed changes to the IOUs' programs requires an additional step, which is to examine the extent to which other factors, outside the programs, could explain the observed market changes. The following are some additional factors the team will examine:

- Other programs already available in the marketplace could be driving increased efficiency independently of the IOUs' programs and could have led to the observed market changes.

The team will ask builders, Title 24 consultants, HERS raters, and managers of other voluntary program to what extent this is the case.

- Outside forces such as gasoline prices, housing market cycles, and global warming could be driving demand for efficiency and could have led to the observed market changes, independently of the IOUs' programs and other voluntary programs. The team will ask builders, Title 24 consultants, HERS raters, and other program managers to what extent this is the case.
- The market could be developing at a "natural" rate and the observed market changes could have happened in the absence of the IOUs' programs and other voluntary programs. The team will ask builders, Title 24 consultants, HERS raters, and other program managers to what extent this is the case.

4 Plan Overview

The study will be performed in two phases. The first phase will cover the market and attribution analysis of the CA new construction programs, resulting in an interim report to be delivered by November 26, 2008. Phase I will be largely qualitative, aiming to establish whether or not there is substantial evidence of increases in the efficiency of the residential new construction market—beyond the direct effects of the IOUs programs—that may reasonably be attributed to those programs; Phase II will involve quantifying those market effects. The Phase I activities proposed by the CIEE market effects team are presented in Table 4.

Table 4: Summary of Residential New Construction Market Effects Study—Phase I

1. Analysis of Market Evolution	• Reconstruct historical trends concerning energy efficiency in the RNC market in California o Identify trends among non-participating builders/homes
2. Analysis of Market Effects, Part I	• Analyze non-participant spillover for years 2006-2008 o Interview larger set of non-participating builders. o Match interview results with onsite data if possible. • Analyze cumulative impact of utility RNC programs (not C&S programs *per se)* on 2005 Title 24 o Interview experts in the homebuilding industry.
3. Attribution Analysis	• Sift through the evidence collected to make a case regarding the role of utility RNC programs in causing the observed market effects.

The work performed under Phase I of the Study will significantly inform the second phase, presented in Table 5; in fact, going ahead with Phase II—which involves quantifying the market effects—is contingent on identifying significant market effects (qualitatively) in Phase I. If Phase II occurs, the RLW team will conclude research activities by September 18, 2009 and deliver a Draft Final Report by October 9, 2009.

Table 5: Summary of Residential New Construction Market Effects Study—Phase II

Task	Research Activities
Plan	• Develop a plan for Phase II
1. Analysis of Market Effects, Part II	• Develop a hypothetical baseline of RNC efficiency trends in California[15] o Utilize onsite data from inspection of homes o Interview non-participating builders and other actors in the homebuilding industry. • Estimate market effects by comparing actual (from Phase I) and baseline RNC practices.
2. Attribution Analysis	• Sift through the evidence collected to make a case regarding the role of utility RNC programs in causing the observed market effects.
3. Estimation of Net Energy and Demand Savings	• Convert market effects to estimated energy and demand savings. o Systematically analyze the uncertainty surrounding the results. • Develop recommendations regarding treatment of any RNC market effects savings in next program cycle.
4. Sustainability Assessment	• Assess the extent to which any observed market effects are likely to persist in the absence or reduction of public intervention.

The remainder of this work plan focuses primarily on the RLW team's approach to performing the research activities specified in Table 5 for Phase I of the project. Because Phase II is so

[15] As discussed later in this plan, "baseline" refers to a hypothetical projection of sales patterns of energy-efficient residential new homes in the complete historical absence of publicly funded energy efficiency programs targeting residential new construction (but including building codes)

highly dependent on the results of Phase I and data available through other evaluation contractor activities, Phase II is summarized briefly rather than discussed in detail.

Table 6 below shows the sources by which the key indicators will be measured. Please note that the team will be flexible in identifying program outcomes and indicators as the evaluation progresses, so this list may not be final; it is also likely that evaluation resources will not allow measurement of all indicators. The numbers in the first column refer to the links in the program logic model in Figures 2 and 3. The second column presents the program theory associated with the intervention represented by that particular link, with the potential indicator(s) of that program intervention listed below each theory statement. The potential indicators are listed alphabetically along with the numerical link identifier in the first column. The third column identifies the potential data sources for each indicator.

Table 6: Sources for Measurement of Indicators

Link/Indicator number	*Theory* and Indicators	Sources
1	***IOU programs leverage other voluntary efficiency programs***	
1A	Managers of other efficiency programs say that some of their efficiency criteria are based on the IOU program criteria	Interviews with managers of other voluntary programs
1B	Managers of other efficiency programs say the IOU programs increase participation in their programs	Interviews with managers of other voluntary programs
2	***IOU incentives for builders, leveraging other available incentives, decrease the cost of increased efficiency***	
2A	Participating builders report that the IOU incentives combined with other incentives have significantly decreased the incremental cost of increased efficiency	NC/CS Impact Evaluation
2B	Manufacturers report that the IOU incentives combined with other incentives have significantly decreased incremental costs for efficient technologies	Interviews with manufacturers; Historical trends in measure costs
3	***IOU incentives for builders induce them to increase their marketing of efficiency***	
3A	Participating builders report increasing their marketing of efficiency because of IOU programs and incentives	NC/CS Impact Evaluation
3B	Number of participating builder ads and signs mentioning efficiency increases	NC/CS Impact Evaluation
4	***Program Plan Check catches and corrects modeling errors on participating homes. The feedback educates Title 24 consultants, which improves the modeling of existing homes***	
4A	Title 24 consultants say Program Plan Check catches modeling errors on participating homes;	Interviews with Title 24 consultants
4B	Title 24 consultants say Program Plan Check has helped improve their modeling of non-participating homes	Interviews with Title 24 consultants

Link/Indicator number	*Theory* and Indicators	Sources
5	***IOUs' research & development of new technologies and practices and case studies on their deployment show builders that the new technologies and practices are feasible***	
5A	Many participating builders and some non-participating builders are aware of the proven practicality of using the new technologies and practices	NC/CS Impact Evaluation; Interviews with non-participating builders
6	***Training of participating builders in new technologies and practices leads to increased builder knowledge***	
6A	Many participating builders and their subcontractors—and through subcontractors, some non-participating builders—become more knowledgeable of new technologies and practices	NC/CS Impact Evaluation; Interviews with non-participating builders and subcontractors; Historical trends in builder knowledge
7	***Training of code officials leads to improved compliance with the building code***	
7A	Rate of compliance increases	Training of code officials is to be addressed by the Local Government Impact Evaluation.
7B	The incidence of compliance is higher in municipalities whose code officials have received PG&E-sponsored compliance training	Not to be examined in this evaluation
8	***HERS rating requirements for program participation ensure that above-code practices promoted through the program are implemented in participating homes***	
8A	On-site inspections of participating homes shows that above-code practices are implemented	NC/CS Evaluation
9	***IOUs' advertising and outreach causes builders to increase their own marketing of efficiency***	
9A	Many participating builders market energy efficiency as a feature of their homes	NC/CS Impact Evaluation
9B	Number of builder ads and signs mentioning efficiency increases	NC/CS Impact Evaluation
10	***IOUs' advertising and outreach increases home buyers' awareness of energy efficiency and associated benefits including cost savings, comfort, health, and home durability***	

Link/Indicator number	***Theory* and Indicators**	**Sources**
10A	Participating home buyers and non-participating home buyers become more aware of energy efficiency as an important feature of new homes, hearing about it from IOUs' advertising and outreach	NC/CS Impact Evaluation; Survey of non-participating home buyers; Historical trends in home buyer awareness
11	***Builders' marketing increases home buyers' awareness of energy efficiency and associated benefits including cost savings, comfort, health, and home durability***	
11A	Participating home buyers and non-participating home buyers become more aware of energy efficiency as an important feature of new homes, hearing about it from builders	NC/CS Impact Evaluation; Survey of non-participating home buyers; Historical trends in home buyer awareness
12	***Increased home buyer awareness causes an increase in home buyer demand for energy efficiency and an increase in willingness to pay***	
12A	Participating home buyers and non-participating home buyers ask builders about the efficiency of homes	NC/CS Impact Evaluation; Survey of non-participating home buyers; Historical trends in home buyer attitudes
12B	Participating home buyers and non-participating home buyers rank efficiency more highly on lists of desired home attributes;	NC/CS Impact Evaluation; Survey of non-participating home buyers; Historical trends in home buyer attitudes
12C	Participating home buyers and non-participating home buyers express greater willingness to pay the incremental costs	NC/CS Impact Evaluation; Survey of non-participating home buyers; Historical trends in home buyer attitudes
13	***Increased home buyer demand for energy efficiency causes an increase in builder marketing of efficiency***	
13A	Participating builders and non-participating builders perceive an increase in home buyer demand for efficiency and therefore increase their marketing of it	NC/CS Impact Evaluation; Interviews with non-participating builders; Historical trends in builder perceptions
13B	Number of builder ads and signs mentioning efficiency increases	NC/CS Impact Evaluation
14	***Increased non-participating builder knowledge leads to greater code compliance***	

Link/Indicator number	*Theory* and Indicators	Sources
14A	Participating builders and non-participating builders as well as local building code officials say program training has help improve code compliance	NC/CS Impact Evaluation; Interviews with non-participating builders; Interviews with local building officials
14B	Rate of compliance increases	Onsite inspections; Historical trends in compliance; Interviews with building department officials; Interviews with Title 24 consultants; Interviews with HERS raters
15	***Improved design and correction of errors through Program Plan Check leads to improved compliance***	
15A	Title 24 consultants say that Program Plan Check has helped them learn more about modeling and improved the compliance of non-participating homes	Interviews with Title 24 consultants; Onsite inspections
15B	Rate of compliance increases	Onsite inspections; Historical trends in compliance; Interviews with building department officials; Interviews with Title 24 consultants; Interviews with HERS raters
16	***The decreased cost of energy-efficient technologies and practices encourages economies of scale and helps decrease their incremental cost beyond the amount of the incentive***	
16A	Manufacturers and builders report decreases over time in the incremental costs of energy-efficient technologies and practices	Interviews with manufacturers; NC/CS Impact Evaluation; Interviews with non-participating builders; Historical trends in measure costs
17	***Increased economies of scale for energy-efficient technologies and practices leads to their adoption by an increasing number of builders***	
17A	Some participating builders and a few non-participating builders report decreasing incremental costs of energy-efficient technologies and practices as a factor encouraging their use	NC/CS Impact Evaluation; Interviews with non-participating builders; Historical trends in builder perceptions

Link/Indicator number	*Theory* and Indicators	Sources
17B	The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time	Onsite inspections; Historical trends in energy-efficiency technologies and practices; Interviews with HERS raters
18	***Improved design leads to increased above-code practices among participating and non-participating builders***	
18A	Title 24 consultants say that Program Plan Check has helped them learn more about modeling and improved above-code design of participating and non-participating homes	Interviews with Title 24 consultants
18B	The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time	Onsite inspections; Historical trends in energy-efficiency technologies and practices; Interviews with HERS raters
19	***The demonstration of feasibility of energy-efficient technologies and practices leads to their adoption by an increasing number of builders***	
19A	Participating builders and non-participating builders who are aware of IOUs' R&D and case studies are more likely than others to try the new technologies and practices	NC/CS Impact Evaluation; Interviews with non-participating builders; On-site inspections
19B	The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time	Onsite inspections; Historical trends in use of energy-efficient technologies and practices; Interviews with HERS raters
20	***Increased knowledge about energy-efficient technologies and practices leads to their adoption by an increasing number of builders***	
20A	Some participating builders and a few non-participating builders who became knowledgeable about new energy-efficient technologies and practices (directly or indirectly) through IOUs' training are more likely than others to try the new technologies and practices	NC/CS Impact Evaluation; Interviews with non-participating builders and subcontractors; On-site inspections

Link/Indicator number	*Theory* and Indicators	Sources
20B	The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time	Onsite inspections; Historical trends in use of energy-efficient technologies and practices; Interviews with HERS raters
21	***Verification of above-code practices by Program Plan Check provides feedback to designers and builders which makes achieving program requirements easier as time goes on***	
21A	Participating and non-participating builders and Title 24 consultant say modeling and building above code becomes easier over time because of feedback from Program Plan Check	NC/CS Impact Evaluation; Interviews with non-participating builders and subcontractors
	Above-code practices observed in on-site inspections increase over time	NC/CS Impact Evaluation; On-site inspections
22	***Increased builder marketing of efficiency by some builders leads other builders to adopt energy-efficient technologies and practices***	
22A	Non-participating builders who are aware of increased marketing of efficiency by other builders are more likely than others to try the new technologies and practices	NC/CS Impact Evaluation; Interviews with non-participating builders and subcontractors; On-site inspections
22B	The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time	Onsite inspections; Historical trends in use of energy-efficient technologies and practices; Interviews with HERS raters
23	***Increased demand from home buyers for energy-efficient technologies and practices leads to their adoption by an increasing number of builders***	
23A	Some participating builders and a few non-participating builders report increasing home buyer demand for energy-efficient technologies and practices as a factor encouraging their use	NC/CS Impact Evaluation; Interviews with non-participating builders and subcontractors; Historical trends in builder perceptions

Link/Indicator number	*Theory* and Indicators	Sources
24	***Increased home buyer demand for energy efficiency causes appraisers to assign value to efficiency and lenders to provide energy efficient mortgages (EEMs), which in turn increases home buyer demand***	
24A	Appraisers and lenders perceive an increase in home buyer demand for efficiency and, respectively, assign more value to it and make more EEMs available	Not to be examined in this evaluation
24B	Home buyers are aware of appraisers assigning value to efficiency and lenders providing EEMs, which increases home buyer demand	NC/CS Impact Evaluation; Survey of non-participating home buyers; Historical trends in home buyer attitudes
25	***Enough builders are using energy-efficient technologies and practices such that the market is prepared for a code upgrade***	
25A	The incidence of energy-efficient technologies and practices, as observed in evaluators' on-site inspections of participating and non-participating homes, becomes a significant part of the market	Onsite inspections; Historical trends in use of energy-efficient technologies and practices; Interviews with Title 24 Consultants; Interviews with HERS raters
25B	Key builders and industry experts indicate that there is enough knowledge and availability of efficient technologies and practices in the marketplace that the code could be upgraded and most builders could comply within a reasonable time	NC/CS Impact Evaluation; Interviews with non-participating builders and subcontractors; Interviews with Title 24 Consultants; Interviews with HERS raters
26	***Improved code compliance with the current code improves the least efficient end of the market and helps prepare the market for a code upgrade***	
26A	Key builders, industry experts and local code officials say that compliance with the current code has reached the point where builders at the low end of the market could comply with a new upgrade within a reasonable time	Interviews with non-participating builders; Interviews with Title 24 Consultants; Interviews with HERS raters; Interviews with local building officials
27	***The market proves ready and the code is upgraded***	

Link/Indicator number	*Theory* and Indicators	Sources
27A	Key builders and industry experts indicate that the IOUs' programs have contributed to market readiness for a code upgrade that has occurred or is planned, thus consolidating and ensuring the sustainability of efficiency gains	NC/CS Impact Evaluation; Interviews with non-participating builders and subcontractors; Interviews with industry experts
27B	Utility measures incentivized in the 2006-2008 programs are part of the 2008 code, or are in the draft language for the 2011 code.	Review of program incentives; review of 2008 code and draft language for 2011 code
28	***Improved compliance with existing code leads to reduced energy use, demand, and emissions***	
28A	Energy use and associated emissions as well as demand in non-participant homes are lower than in the baseline, non-program case	Interviews with local building department officials; On-site inspections; Comparison with baseline; Calculation of energy, demand, and emissions savings; this will occur in Phase II of the project
29	***Increased use of energy-efficient technologies and practices in non-participant homes, above the current code, leads to reduced energy use, demand, and emissions***	
29A	Energy use and associated emissions as well as demand in non-participant homes are lower than in the baseline, non-program case	On-site inspections; Comparison with baseline; Calculation of energy, demand, and emissions savings; this will occur in Phase II of the project
30	***An upgrade in the building code leads to reduced energy use, demand, and emissions***	
30A	Energy use and associated emissions as well as demand in non-participant homes are lower than in the baseline case without a code upgrade	On-site inspections; Comparison with baseline; Calculation of energy, demand, and emissions savings; this will occur in Phase II of the project

5 Plan for Phase I

5.1 Task 1: Analysis of Market Evolution

In this step of the analysis, the project team will examine the historical context of RNC design and construction practices in California in order to identify the market dynamics and current conditions in which the California efficiency programs are deployed, to help establish the design and construction practice trends against which the influence of the programs will be compared to determine effects including non-participant spillover, and to assess long-term trends that may provide indications of "market readiness" preceding changes in code. At this point in the evaluation, the team will remain "agnostic" about the baseline and market effects, focusing instead on establishing what in fact has happened over the past several years. This assessment is a key element of the research as it will provide the foundation for establishing the baseline and the net savings analysis to be conducted in Phase II of the project.

The historical trend analysis will focus on the following components:

- Historical trends in RNC efficiency practices in California
- Historic trends in builders' awareness and attitudes
- Historic trends in home buyer awareness and attitudes
- Historic trends in incremental costs of efficiency measures

Key issues to be addressed in this step of the study include:

1. **Assessment of the historical trajectory of building energy codes in the state and their influence on building design and construction practices** – The need for the implementation of building energy efficiency standards was first recognized in the early 1970s and mandatory standards were first adopted in the State in 1978. Since then the State building energy codes (codified in Title 24) have evolved and been updated to reflect ongoing changes in building practices and the market acceptance of certain efficient building practices. The current standard (2005) was adopted in November of 2003 by the Energy Commission and in July of 2004 by the Buildings Standards Commission, and took effect in October of 2005. This has led to a level of efficiency across the state that likely exceeds most other areas of the country, and fixes the baseline from which California programs seek to exert their influence at a relatively high level. The program period that is the focus of this study is 2006-08 and the definition of practices up to this point in time needs to be defined as part of this task, including changes in Title 24.
2. **Distinguishing between whole-house and component compliance** – Title 24 has historically offered both component prescriptive and performance-based compliance tracks. Similarly, utility programs have offered incentives and services aimed at

improving both component efficiency and whole building performance. At the end of the day, it is the net at-the-meter or whole building demand and energy savings that count toward utility savings achievement goals; however, it is still useful for the purposes of the understanding the effects of the programs on the market as a whole to distinguish between these different but related influences that impact non-participant builders. To that end, in this task we will attempt to establish trends in both individual components as well as whole-house performance

3. **Assessment of as-specified versus as-built performance** – Field performance of the building thermal envelope and home energy systems often falls short of specified performance.[16] Insofar as historical documents allow, we will attempt to establish differences between as-specified and as-built performance.
4. **Training for improved enforcement of code requirements** – Energy codes and standards are only capable of reaching their potential for reducing energy use if they are effectively implemented and enforced. Building departments are often challenged trying to enforce compliance with energy codes in addition to life, health, and safety codes. Certain energy-efficiency programs in the state have directed their attention at providing training to improve code enforcement, and ultimately compliance, and the success of these efforts is an area of research for the market effects study.
5. **Going beyond code minimum requirements** – While codes and standards set minimum performance standards, it is always possible to exceed this common denominator and improve building energy efficiency. Some of the programs in the state have focused on encouraging energy efficiency performance that goes beyond the minimum code requirements. The extent of such practices in new construction market as a whole, especially non-participants, will be an area of investigation in this study.

The primary research tasks for this step of the process will be a detailed literature review and interviews with knowledgeable trade allies in the industry. The project team's proposed approach to each of these components is discussed below.

5.1.1 Task 1-1: Assess historic trends in RNC efficiency practices in California

The design and specification of new homes in California has been heavily influenced for over three decades by the state's building energy efficiency standards. California has been promoting building energy efficiency standards since the mid 1970's and the current standards are codified in Title 24 of the states administrative code. Similarly, Title 20 has set minimum standards for common household appliances installed in new homes. Title 24 is among, if not the most, aggressive and progressive building energy codes in the country.

[16] Please note that as-built homes have also been found to be better than as-specified.

5.1.1.1 Task 1-1-1: Conduct literature review of RNC studies and evaluation research.

As a first step in the process, the project team will conduct a literature search and review of relevant studies available in California. An initial list of candidate studies is provided in Table 7, which we will complete during the literature review. From these studies the project team will glean insights into the evolution of California building energy codes and standards, building construction characteristics influenced by code changes, new construction market characteristics and dynamics, the influence of other standards such as ENERGY STAR on the residential new construction market, and other parameters that will help to establish the context and background for the Residential New Construction Market Effects study (which is primarily focusing on the market effects from programs implemented in 2006-2008).

Table 7: Possible Sources for Assessing Efficiency Trends

	CALMAC ID	Year Built	Stds	Published	Type	Lead	Title
1	PGE0234.01			2005	Planning	RLW	*2006 Residential New Construction Strategy Assessment*
2	PGE0181	2002-2003	2001	2004	Baseline	Itron	*Residential New Construction Baseline Study of Building Characteristics Homes Built after 2001 Codes*
3	PGE0105	1998-1999	1995	2001	Baseline	Itron	*Residential New Construction Study*
4	PGE0104	1999-2000	1998	2002	Baseline	Itron	*Residential New Construction Study: Project Year #2*
5	PGE0153	2000-2002	1998*	2003	Baseline	Itron	*Statewide Multifamily New Construction Energy Efficient Baseline Study*
6	PGE0218	2004-2006			Eval	RLW	*Evaluation, Measurement and Verification of the 2004 & 2005 California Statewide ENERGY STAR New Homes Program*
7	PGE0208	2002-2004			Eval	RLW	*Evaluation, Measurement and Verification of the 2002 & 2003 California Statewide ENERGY STAR New Homes Program—Phase II Report*
8	PGE0092	1992-1998	mult	1999	ME	Itron	*1998 PG&E Comfort Home Program Market Baseline and Market Effects Study*
9	PGE0072						*Impact Evaluation of PG&E's 1996 Residential New Construction Program*
10	PGE0035, 0013						*Impact Evaluation of the Residential New Construction Program*
11	SCE0079		1992	1996		B&C	*Residential New Construction Market Characterization*
12	SCE0215, 0152, 0151, 0101, 0099, 0093	N/A	N/A	1999-2006			*California Residential Efficiency Market Share Tracking*
13	SCE0155, 3501, 3301						*Residential New Construction Market Transformation Study*
14	SDG0107						*Residential Market Effects Study*
15	SCG0030						*First Year Impact Study of SCG's Advantage Home Program*
16	SDG0003						*Energy Partnership Home Program Study*
17	CAL0003						*Statewide Residential New Construction Utility Program Comparison Study*
18							*California's Building Energy Efficiency Standards*
19				2005			*2005 Building Energy Efficiency Standards, Residential Compliance Manual*

5.1.1.2 Task 1-1-2: Report results of historic trends in RNC efficiency practices in California.

The prior subtask will yield results that will allow the team to develop tables and graphs that show how installation of energy efficient measures/practices in newly built single family homes have evolved over time. The team plans to start with the detailed databases available from the

three most recent baseline studies (homes built between 1998 and 2003) and add to them other on-site and self-report data available from other RNC studies conducted in California. The literature review will help to identify all other data sources available.

5.1.2 Task 1-2: Assess historic trends in builders' awareness, attitudes and practices

The prior task will be used to investigate the "paper trail" of the recent history of the progression of energy efficiency in new home construction in California, and confirm key design and construction features through targeted and selective site investigations (see Section 3-1). Clearly, however, the influence of the builder community in terms of adoption of the code to the unique requirements of each project, compliance with its changing features over time, and the translation of specifications into as-built conditions is at the heart of the matter. In this task, in collaboration with the NC/CS evaluation, the project team will analyze past studies to reconstruct historic trends in indicators of builders' awareness, attitudes, and stated practices:

- Their awareness of code requirements and changes in code with a focus on the period immediately leading up to the code change in 2005 (the last time the code was changed)
- The influence of the code and other standards on design specifications for key energy components including insulation levels, window performance, HVAC system performance, etc.
- The influence of the code on building practices including builder requirements of key subcontractors (i.e., framers, insulation contractors, HVAC contractors) and subcontractor performance
- The influence of other standards such as ENERGY STAR with a focus on the influence of envelope and duct leakage testing procedures
- The influence of HERS raters and the HERS rating practice on both design features and construction practices
- Perceptions of the demand for energy efficiency features by homebuyers and drivers in their interest and decision-making procedures

5.1.3 Task 1-3: Assess historic trends in home buyer awareness and attitudes

While builders are ultimately responsible for the deployment of design and construction practices that influence residential energy efficiency, they are highly sensitive to and respond first and foremost to consumer demand. In some cases, builders can influence consumer demand, although in the end it is consumer demand for specific features—whether they are aesthetic, functional, locational or related to energy efficiency—that drives builder decisions. Thus, it is important to understand the development in recent years of home buyer awareness of and purchase criteria for energy efficiency features. This includes assessing the influence of a wide range of influences and contemporary messages in the market such as ENERGY STAR, media

reports and other information sources on climate change, and rising energy costs, and trying to discern the difference between the influence of these broad market messages and the direct interventions and messaging offered by utility programs. In this task, the project team will examine past studies of California home buyers to assess trends in the development of their awareness of energy efficiency benefits and costs, their attitudes toward energy efficiency options, the source(s) of their information on energy efficiency, and their purchase criteria and decision-making processes. The focus of the research will be home buyers purchasing homes prior to the 2006-08 time period with a view toward establishing baseline awareness and attitudes prior to the interventions employed by utility programs in the program years 2006-08.

5.1.4 Task 1-4: Assess historic trends in incremental costs of efficiency measures

Market effects of efficiency programs extend beyond the influences on the design, specification and installation of energy efficiency measures to the availability and maturity of products and services in the market and the cost of those products. In this task, the project team will examine the history of the incremental and/or installed cost of energy efficiency measures employed in new home construction. This will include an examination of both component or stand-alone technology incremental/installed costs and whole building incremental costs. For most applications the appropriate cost consideration is the incremental cost of a higher efficiency technology or bundle of technologies compared to a standard efficiency technology or bundle of technologies. The primary source of information for analysis of stand-alone technologies will be the Database for Energy Efficiency Resources (DEER) database and the historical record of DEER reports.[17] Secondary data sources will also be examined, such as R.S. Means. Whole-building pricing is a different perspective and is relative to builder and subcontractor pricing practices and the interaction of cost components from the whole building perspective. Thus, the primary source of information for the whole building analysis will be the builder interviews conducted for past studies by the utilities or others, along with secondary sources such as R.S. Means. Again, the primary objective for this task is to establish pricing trends prior to the 2006-08 time period with a view toward establishing baseline incremental costs prior to the interventions employed by utility programs in the program years 2006-08.

5.2 Task 2: Analysis of Market Effects, Part 1

In this section, we present our general approach to analyzing the key market effects of the RNC programs, based on what is known about data collection activities from other CPUC evaluation contractor teams, the types of secondary sources that will inform the analyses, and any additional primary data collection needs identified at this time that are not already covered by the NC/CS and Marketing and Outreach (M&O) impact evaluation contractor team activities. The data

[17] Larger builders likely get equipment closer to wholesale/distributor pricing. Though this may not change the incremental costs of high-efficiency measures, we will work with the DEER team to understand the past and current prices listed as well as the new ranges that are being developed for some measures.

collection for this task will involve on-site visits at non-participant homes, interviews with non-participant builders, and interviews with market actors. Some of these data collections will already be occurring as part of the NC/CS evaluation, which we will leverage for this evaluation. There will also be some additional data collection for the RNC Market Effects Study. These data collection efforts are summarized in Table 8.

Task 2 has three primary components, corresponding to links 23, 24, and 25 in Figure 2 and Figure 3, leading to reductions in energy use, demand, and emissions:

1. *Estimating the extent of spillover among non-participant builders from performance-based programs that encourage builders to exceed Title 24, as well as programs promoting prescriptive measures, in program years 2006-2008.* Market effects of these programs could be either on the supply side or the demand side, including competition with other builders, increased market demand, indirect education on the benefits and costs of efficient design practices, increased availability of energy-efficient equipment, and lower incremental costs. Some of these market effects could be direct and non-participant builders could be aware of them, while others could be indirect and occur without builders being aware of them. Ultimately, these market effects should lead to reductions in energy, demand, and emissions.

2. *Analyzing the cumulative impact of utility programs on codes and standards, concentrating on program years 1998-2005 leading up to the 2005 code change.* The Codes and Standards evaluation is being conducted separately as part of the NC/CS evaluation and is assessing the effects of utilities' explicit efforts—their C&S programs—to help bring about future changes in code. The RNC Market Effects evaluation, in contrast, assesses two specific effects of the *other* pre-2006 utility residential new construction programs—performance-based programs to exceed Title 24, as well as programs promoting prescriptive measures. One effect is the likely increase in average residential energy efficiency in the market that was an indirect result (spillover or market effects) of the utility programs. For example, builders who did not participate in a high-efficiency furnace program might have begun installing higher efficiency furnaces anyway because customers became aware of them through program publicity and started asking the builder for higher-efficiency furnaces. The second effect is enhanced market readiness for increased efficiency that utility programs induced, which then facilitated the adoption of higher efficiency standards. These two effects are linked and not entirely separable; neither is being estimated in the current NC/CS evaluation. The RNC Market Effects analysis will address both. Code upgrades should lead to reductions in energy, demand, and emissions.

3. *Analyzing the effect of the IOUs' programs on code compliance.* Compliance can increase if the IOUs' programs encourage builders to make sure that everything is built according to code, which would lead to reductions in energy, demand, and emissions.

Table 8: Data Collection Efforts that Will Contribute to Task 2

Task	NC/CS	Market Effects	Total
2-1-1: Builder Interviews and Additional On-Sites	80-100 on-site visits	70 on-site visits to firm up non-participant sample	150-170 on-site visits
		95-100 computer-assisted telephone interviewing (CATI) interviews with builders and subcontractors	95-100 CATI interviews with builders and subcontractors
2-1-2: Market Actor Interviews	20 interviews with building department officials	18 CATI interviews with Title 24 consultants, 30 CATI interviews with building products suppliers, 18 CATI interviews with HERS raters, and 8 in-depth interviews with managers of other voluntary programs; additional questions for 20 building department officials	20 interviews with building department officials, 18 CATI interviews with Title 24 consultants, 30 CATI interviews with building products suppliers, 18 CATI interviews with HERS raters, and 8 in-depth interviews with managers of other voluntary programs
2-1-3: Coordination with Marketing & Outreach Evaluation			TBD
2-1-4: Assessing Consumer Demand	470 interviews with non-participating new home buyers	Additional questions on indicators of demand-side outcomes per the program theory	470 interviews with non-participating new home buyers, including additional questions on indicators of demand-side outcomes per the program theory
2-2: Analyzing the Cumulative Impact of Utility Programs on Codes & Standards	Web-based estimates of naturally occurring market adoption (NOMAD) trends by 10-40 residential building experts. Interviews with 8 experts on C&S Program attribution	Re-estimation of NOMAD without utility RNC programs by 10-40 experts. Expanded interviews with 8 experts on attribution effects of RNC programs.	10-40 experts estimating NOMAD; 8 expert interviews

5.2.1 Task 2-1: Estimate the extent of spillover among non-participant builders

5.2.1.1 Task 2-1-1: Builder interviews and additional on-sites

Being part of the same group, the market effects evaluation team will work with NC/CS RNC evaluation team to identify and classify the population of builders into four types: full participant builders, partial participant builders, possible partial non-participant builders, and full non-participant builders. Firms that have built only participant homes are full participant builders, and firms that have built only non-participant homes are full non-participant builders. Firms that have built both participant and non-participant homes could be either partial participant builders or possible non-participant builders—and we will not be able to identify them as such until they are interviewed. In offices where the builder has built both participant and non-participant homes, the individuals responsible could be influenced by practices learned during the construction of participant homes, which could be participant spillover. In a builder's offices where individuals have been responsible only for non-participant homes, it is possible that they have been influenced by corporate-level learning derived through other offices' participating projects; this could also be participant spillover. In these offices where the individuals responsible have built only non-participant homes, however, it is possible that they were influenced by other factors, such as "competition from other builders, demand in the market, indirect education on the benefits and costs and on efficient design practices, and increased availability (and potentially improved 'price points') of energy-efficient equipment in the marketplace." (Section 7.2.6 of the NC/CS work plan). These builders should represent non-participant spillover, the focus of this market effects evaluation.

This effort will have to be coordinated with the Marketing and Outreach (M&O) Evaluation team to avoid both duplication of effort as well as double counting of savings. Since the M&O Evaluation team is addressing the indirect effects arising from education efforts, the NC/CS market effects team will focus on other effects, using questions developed for non-participant builders (see Task 3-1-3 below).

We propose to interview builders to address market effects questions, including partial participant builders, possible partial non-participant builders, and full non-participant builders. These interviews will be conducted at Itron's CATI center.

If timing allows, we plan on interviewing non-participant builders (and their subcontractors) who built the non-participant homes included in the NC/CS baseline study. In this way, actual practices can be compared with builders' reported practices. In some cases, when the builder's firm has completed both participant and non-participant homes, we won't know until after a home is visited if it is a partial participant or partial non-participant. We will attempt to represent builder staff members with different responsibilities, including those involved in field supervision, design, sales, and management. If possible, we will interview some non-participant builders who have previously participated and some who have not. We expect to interview the following subcontractors: HVAC contractors, framing contractors, insulation contractors, and

electrical contractors. As of now, we expect the NC/CS baseline study team to have completed 80 to 100 on-site visits at non-participating homes—but no metered data—by the end of the summer.[18]

Given that some homes will not qualify as non-participants, and that we will not be able to interview all targeted builders and subcontractors, we initially expect to be able to interview about 25 to 30 builder firms and their subcontractors, or a total of 50 to 65 interviews of those associated with non-participant homes included in the NC/CS study. To increase the number of homes and builders represented, we will conduct on-site inspections of an additional 70 non-participant homes beyond those included in baseline study, and an additional 45 to 50 interviews. Hence, we expect to complete a total of 95 to 110 interviews with builders and their subcontractors representing about 40 to 50 homes for which we will have on-site data.[19] We will design the on-site sample to be able to compare compliance rates in communities whose building department officials have received PG&E's code compliance training with rates in communities whose building department officials have not received such training.

In these interviews, we will ask builders and subcontractors to assess the effect of the utilities' programs on their practices, and to characterize changes in the market over the past few years—e.g., availability and cost of energy-efficiency measures in the market, competition with other builders for energy-efficient homes, changes in design and building practices, changes in consumer demand, rising fuel prices, and the emergence of green building opportunities. We will also ask them how the market downturn has affected their practices—for example, whether they are building more efficiently to distinguish themselves in the market, or less efficiently to reduce costs. Also, we will assess whether subcontractors have worked on participant homes, and if so whether practices learned there are carried over to non-participant homes.

To encourage participation in the interview, and to minimize non-response bias, we will offer an incentive of $150 for each respondent. Even with this incentive, however, there is the possibility of non-response bias; builders who are willing to be interviewed may be better builders than those who are not willing to be interviewed. We will assess and, to the degree possible, compensate for such bias by comparing the efficiency of the homes built by interviewees and the non-interviewees. Even with such bias, however, any non-participant spillover detected would be real; the issue will be how to quantify the spillover and correct for the bias.

5.2.1.2 Task 2-1-2: Market actor interviews

We will conduct interviews with other market actors. We will be adding questions to the interviews with 20 building department officials to be conducted as part of the Codes & Standards (C&S) evaluation. In addition, we will be interviewing 18 Title-24 consultants (from

[18] There will be a total of 470 on-sites in the NC/CS evaluation, but only 80-100 will be completed in time for use in Phase I of the market effects evaluation.

[19] No builder interviews are planned for the NC/CS evaluation.

the CABEC.org website), 30 building product suppliers (HVAC, insulation, windows, appliances, fixtures & controls), and 18 HERS raters; these interviews will be conducted through Itron's CATI center. We will also conduct eight in-depth interviews among managers of other (non-IOU) voluntary residential new construction programs. Among all these groups, we will ask them to assess program effects that non-participant builders may not be aware of and thus cannot account for in self-reports—e.g., the extent to which high-efficiency water heaters and furnaces are spillover from the program or result from market changes, and the extent to which the incidence of refrigerant charge and airflow (RCS) practices versus thermal expansion valve (TXV) installation is influenced by the program. We will also ask for their assessment of the effect of the market downturn on building practices. Among managers of other (non-IOU) voluntary residential new construction programs, we will ask about the effects of the IOU programs on their programs, more information about how their programs work, and the size (number of homes) of their programs in California.

While accurate incremental cost estimates would require a separate study, we will also ask market actors for rough estimates of current and historical incremental costs. We will compare these anecdotal data to the previous incremental cost studies conducted for RNC programs and make a recommendation for whether additional work needs to be done in this area in Phase II. Among building product suppliers, we will ask about the quantities of products that they sell that meet the Title 24 standard and exceed the standard, and how much of the latter is due to the program. Among HERS raters, we will ask about the effect of the program on duct leakage and air infiltration.

5.2.1.3 Task 2-1-3: Coordination with Marketing & Outreach Evaluation

We will coordinate with the Marketing & Outreach (M&O) evaluation team to consider how best to account for the effect the statewide umbrella marketing campaign may have on the practices of non-participating builders. The M&O evaluation has three parts. The first part focuses on consumers in general, with no separate effort targeting new home buyers; we see no need to coordinate with this part of the M&O evaluation. The second part of the M&O evaluation focuses on energy centers, including training for builders. This will require some coordination. The third part of the M&O evaluation addresses education and outreach programs, which include code training for builders, green home promotion for builders and consumers, training for builders to build and promote whole-house improvements, and software to capture "invisible savings" in new construction; the evaluation will address effect on builders and will require some coordination as well. The M&O evaluation counts builders as participants if they have attended trainings; hence M&O participants could fit into any of the four categories of builders as defined by the NC/CS evaluation: full participant builders, partial participant builders, possible partial non-participant builders, and full non-participant builders. Part of the coordination with the M&O evaluation team will involve classifying builders into both NC/CS and M&O categories, so that any overlaps can be identified and double counting can be avoided. In addition, we will review past M&O evaluations of RNC programs for any relevant information.

5.2.1.4 Task 2-1-4: Assessing consumer demand

One component of program theory is an increase in consumer demand. Since the NC/CS evaluation includes a survey of non-participating new homebuyers, for which data collection has already started, we included market effects-related questions to include in this survey, focusing on tracking questions asked in previous non-participant surveys. The questions asked in this survey are shown in Appendix D.

5.2.1.5 Task 2-1-5: Analyzing and documenting spillover among non-participant builders

In this task, we will analyze, summarize, and document the findings from Task 2-1-1 (Builder Interviews and Additional On-sites), Task 2-1-2 (Market Actor Interviews), and Task 2-1-4 (Assessing Consumer Demand).

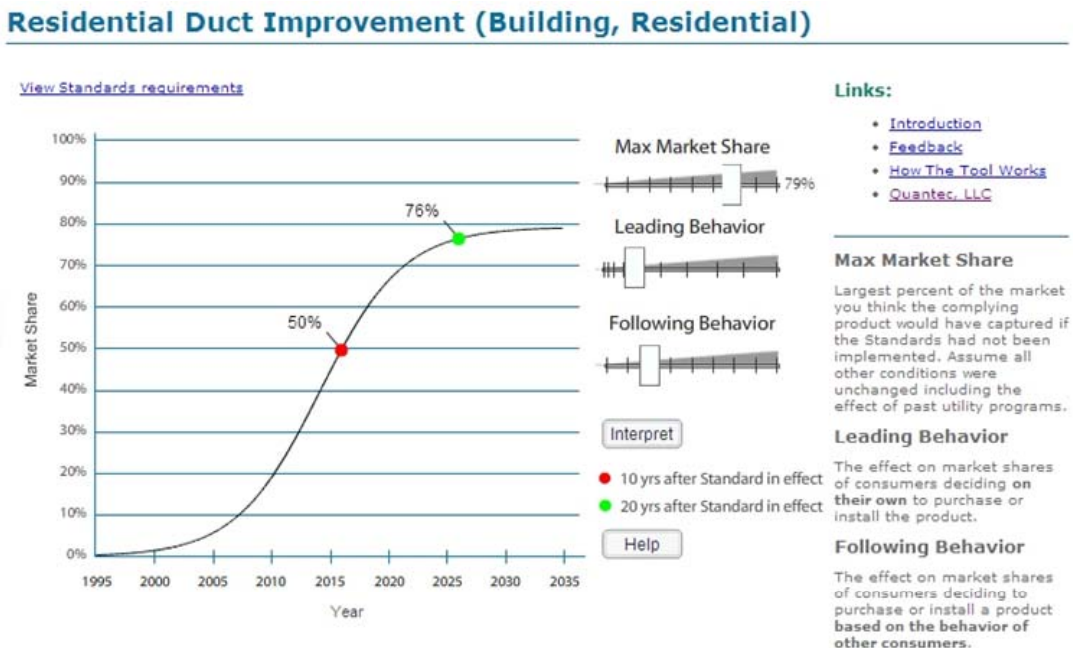
5.2.2 Task 2-2: Analyze the cumulative impact of utility programs on codes & standards

The primary focus of the Codes and Standards (C&S) component of the NC/CS evaluation is on assessing the impacts of the utilities' pre-2006 C&S Programs on adoption of the 2005 Title 24 and the savings attributable to the utilities. Another component of the NC/CS evaluation is monitoring C&S Program activities since the start of 2006 and refining the evaluation methodology that will be used to quantify impacts resulting from the next Title 24 standards. To define the context for the current RNC Market Effects study, it is important to identify links to the NC/CS Program evaluation, which include the following:

1. Past RNC programs had direct impacts on the energy savings attributable to the C&S Program by increasing the "naturally occurring" market adoption (NOMAD) of efficiency measures (above the level required by Title 24) by the amount due to RNC program participation. Since NOMAD is subtracted from gross energy savings to estimate net savings for the C&S Program, not appropriately adjusting for direct savings due to past RNC programs could improperly penalize utilities for these savings from their RNC programs.
2. Past utility RNC programs likely produced market effects that influenced the adoption of new C&S measures by demonstrating them, increasing their market share, increasing market actor familiarity with them, etc.
3. Past RNC programs also have both participant and non-participant spillover effects on the NOMAD of efficiency measures. These are in addition to the direct energy savings from the RNC programs (item 1 above).
4. Current RNC programs are producing market effects that will interact with the impacts of the existing Title 24 standards, affecting the NOMAD estimates that will be used to assess the net effects of the next round of standards likely to go into effect in 2009.

The first link is through the direct energy savings and market penetration of efficient measures installed under past utility RNC programs. NOMAD is being estimated in the NC/CS Program evaluation by asking a group of experts to use a web-based tool to develop a curve depicting how they believe residential energy efficiency (and other efficiency measures) would have changed over time if the most recent Title 24 standards had not been adopted. One example is shown in Figure 5 below from a prior study when experts were asked to predict the market penetration of residential duct improvements. Experts used on-screen sliders to select three parameters—maximum market share, leading behavior, and following behavior—that determined the shape of the market adoption curve for residential duct improvements (Figure 5).

Figure 5: Example of Tool for Experts to Shape Market Adoption Curve



During the NC/CS evaluation, experts providing inputs describing these curves will be asked not to subtract out the direct (or spillover/market) effects of past utility programs (though they will be asked to exclude the effects of any subsequent programs in their estimates). Using available program evaluations and utility information, the NC/CS evaluation will then net out the direct energy savings impacts of past programs from the NOMAD estimate. This will prevent penalizing the utility savings attributed to the NC/CS Program by the amount of direct savings resulting from the past utility programs, though the effect is likely to be relatively small in the context of the overall market.

Regarding the second issue, the effect of past RNC programs on the adoption of the 2005 Title 24, the NC/CS evaluation will exclude this effect because the focus of the NC/CS evaluation is on the impacts of the past utility C&S Programs alone.[20] The NC/CS evaluation will be conducted to minimize the extent to which these effects of historical RNC programs are embedded in the impact estimates. They are an essential component, however, of the RNC Market Effects study.

[20] It is important to note that the last study of C&S Program impacts that addressed attribution implicitly credited effects to the utility non-C&S Programs. This occurred by including a "market readiness" factor that was larger if the utilities had conducted acquisition and other programs directed at technologies and measures for which standards were later adopted. In effect, these market effects of prior utility RNC programs were being credited toward the energy savings that were attributed to the C&S Program.

The third link is through spillover effects from past RNC programs on subsequent energy savings and market penetration of efficiency measures. These effects also would be embodied in experts' NOMAD estimates, potentially shifting the estimated market adoption curve upward. In the RNC Market Effects study, we will examine these effects after the experts have estimated the NOMAD curve by asking them what percent of their estimated market penetration at the beginning of 2006 they believe was due to market effects of the prior utility RNC programs. This will be an independent estimate of the market effects. Under the assumption that the NOMAD curve would have shifted downward this amount if the prior utility programs had not occurred, this shift will provide an estimate of the ongoing market effects from prior programs. This estimate will not affect the savings attributed to the C&S Program in the 2006-08 period. This methodology, however, will be demonstrated and tested for consideration in future evaluations if the CPUC policy permits taking spillover and market effects into account.

The final link is the relationship between 2006-08 RNC programs and the impacts of the C&S Program. The ongoing evaluations of the RNC programs will estimate their savings, and these will be used in the next NC/CS evaluation. The information from these evaluations, as well as the Market Effects evaluation, will be important inputs to the next NC/CS evaluation.

The NC/CS Program evaluation and this Market Effects study comprise the first comprehensive evaluation of the RNC and C&S Programs as well as an effort to assess specific market effects. Consequently, the study is establishing an analytic starting point and fleshing out an appropriate evaluation methodology. Specific tasks that will be conducted in the RNC Market Effects study to supplement the C&S research in the NC/CS evaluation are summarized below:

1. To ensure that experts provide attribution estimates related to the past utility programs, in the RNC Market Effects study we will compile summaries of these programs describing the program characteristics, schedules, scope, and estimated impacts. This information will be conveyed to the experts providing attribution estimates and they will use it to inform their estimates. For purposes of the RNC Market Effects study, this activity will be expanded from what was originally planned for the NC/CS Program evaluation and will be coordinated with other steps in the RNC Market Effects study, particularly Tasks 1-2-1 and 2-1-1.
2. Adjustment of the NOMAD estimates for the direct program acquisition energy savings effects of past utility programs was already intended as part of the NC/CS evaluation. This effort will be expanded, as needed, and coordinated with the other tasks in the RNC Market Effects study.
3. One spillover and market effects area associated with past programs affecting RNC is the effect on NOMAD of higher efficiency building practices and measures. The RNC Market Effects study will provide an estimate of these impacts by requesting an independent estimate of these effects of past programs from the experts providing NOMAD estimates. The initial NOMAD estimation is part of the NC/CS evaluation; the Market Effects study adds a step requesting the same experts to estimate how

much effect past programs had on the projected growth in residential efficiency that would have occurred without the 2005 Title 24 standards. We will provide relevant program information to our participating experts to inform their estimation of the spillover and market effects. The adjustment will then be used to estimate the influence on the overall NOMAD curve and the market effects.

4. The other major estimate to be produced in this Market Effects task is the degree to which past RNC programs influenced the efficiency level that was successfully adopted in the 2005 Title 24. We will add this exercise to the attribution analysis that is being conducted as part of the C&S Program evaluation. The C&S Program attribution analysis examines the amount of credit the utility C&S Program should receive for adoption of the 2005 residential Title 24. This Market Effects task applies a similar methodology to derive an estimate of how much Title 24 savings could be attributed to the utility non-C&S Programs. The same staff conducting the C&S Evaluation attribution analysis will expand their analysis to address the role of the past RNC programs in the adoption of the residential Title 24. The same experts who will be assessing other attribution factors in the NC/CS evaluation will be provided information about the relevant historical RNC programs and asked to estimate the effect these programs had on the adoption of the 2005 Title 24. Given the magnitude of savings produced by these standards, this market effect component has the potential to be significant if a clear link exists between past RNC programs and the level of Title 24 that was adopted.
5. As part of the Market Effects study, the ongoing NC/CS evaluation monitoring of recent and continuing Title 24 activities will be enhanced to track information that will be needed to assess market effects of current RNC programs on the next Title 24 standards. The analysis and findings from the evaluations of current RNC programs will be closely tracked and reviewed. A methodology will be designed to collect and analyze this information so that it is readily usable during the next NC/CS Program and RNC Market Effects evaluations.

Table 9 below shows the potential components contributing to the adoption of Title 24 (for 2005) that the Market Effects study, in conjunction with the NC/CS evaluation, will attempt to quantify.

Table 9: Components Helping to Enable 2005 Title 24 Adoption

NOMAD
Direct effects of pre-2006 RNC programs
Participant spillover effects of pre-2006 RNC programs
Effects of pre-2006 C&S programs
Non-participant spillover effects of pre-2006 RNC programs

5.3 Task 3: Assessment of Attribution

In this task we will summarize the extent to which observed market changes can be attributed to the IOUs' programs, including the following:

1. The extent to which the market effects related to changes in non-participant builders' above-code practices that occurred in the years 2006-2008 may be attributed to the utilities' 2006-2008 RNC programs
2. The extent to which the market effects related to improved code compliance may be attributed to the IOUs' 2006-2008 RNC programs
3. The extent to which the market effects helping to enable the 2005 code change may be attributed to the utilities' programs in years 1998-2005

(In addition, there is a fourth set of market effects that this evaluation will not examine, because it is being covered by the Local Government Evaluation: the extent to which improved code enforcement and compliance, if they exist, may be attributed to the IOUs' [specifically PG&E's] code enforcement training.)

We will use a preponderance of evidence approach, based on information from a wide range of sources, comparing what occurred to what was expected to occur given program theory, examining whether alternative hypotheses are supported by the data, and determining whether changes are consistent with one another. We will assess the indicators from the program theory, including current values compared with past values, if available, and determine whether the direction of change is consistent with program theory. Insofar as possible, we will separate the effects of previous program years from those of 2006-2008. Essentially, this will be a story. Table 10 shows a hypothetical and abbreviated set of market indicators and how we might assess changes in these indicators in the attribution analysis. Similar to Table 6, the first column references the links presented in Figures 2 and 3.

Table 10: Hypothetical Attribution of Market Effects

Link/ Indicator number	*Theory* and Indicators	Change Observed	Change Consistent with Market and Program Theory	Likelihood Of Change Being Attributable To Utilities' Programs
1	***IOU programs leverage other voluntary efficiency programs***			
1A	Managers of other efficiency programs say that some of their efficiency criteria are based on the IOU program criteria	Not measured	Yes	High
1B	Managers of other efficiency programs say the IOU programs increase participation in their programs	Not measured	Yes	High
2	***IOU incentives for builders, leveraging other available incentives, decrease the cost of increased efficiency***			
2A	Participating builders report that the IOU incentives combined with other incentives have significantly decreased the incremental cost of increased efficiency	Higher	Yes	High
2B	Manufacturers report that the IOU incentives combined with other incentives have significantly decreased incremental costs for efficient technologies	Higher	Yes	High
2C	Non-participating builders report decreased incremental costs for efficient technologies	Mixed	No	Not Applicable (NA)
3	***IOU incentives for builders induce them to increase their marketing of efficiency***			
3A	Participating builders report increasing their marketing of efficiency because of IOU programs and incentives	Higher	Yes	High
3B	Number of participating builder ads and signs mentioning efficiency increases	Mixed	No	NA
4	***IOUs' research & development of new technologies and practices and case studies on their deployment show builders that the new technologies and practices are feasible***			
4A	Many participating builders and some non-participating builders are aware of the proven practicality of using the new technologies and practices	Higher	Yes	Moderate
5	***Training of participating builders in new technologies and practices leads to increased builder knowledge***			

Link/ Indicator number	*Theory* and Indicators	Change Observed	Change Consistent with Market and Program Theory	Likelihood Of Change Being Attributable To Utilities' Programs
5A	Many participating builders and their subcontractors—and through subcontractors, some non-participating builders—become more knowledgeable of new technologies and practices	Same	No	NA
6	***Training of code officials leads to improved enforcement of the building code***			
6A	Rate of compliance increases	Higher	Yes	Moderate
6B	The incidence of compliance is higher in municipalities whose code officials have received PG&E-sponsored compliance training	Not measured	Yes	High
7	***IOUs' advertising and outreach causes builders to increase their own marketing of efficiency***			
7A	Many participating builders market energy efficiency as a feature of their homes	Higher	Yes	High
7B	Number of builder ads and signs mentioning efficiency increases	Mixed	No	NA
8	***IOUs' advertising and outreach increases home buyers' awareness of energy efficiency and associated benefits including cost savings, comfort, health, and home durability***			
8A	Participating home buyers and non-participating home buyers become more aware of energy efficiency as an important feature of new homes, hearing about it from IOUs' advertising and outreach	Higher	Yes	High
9	***Builders' marketing increases home buyers' awareness of energy efficiency and associated benefits including cost savings, comfort, health, and home durability***			
9A	Participating home buyers and non-participating home buyers become more aware of energy efficiency as an important feature of new homes, hearing about it from builders	Mixed	No	NA
10	***Increased home buyer awareness causes an increase in home buyer demand for energy efficiency and an increase in willingness to pay***			
10A	Participating home buyers and non-participating home buyers ask builders about the efficiency of homes	Higher	Yes	Moderate

Link/ Indicator number	*Theory* and Indicators	Change Observed	Change Consistent with Market and Program Theory	Likelihood Of Change Being Attributable To Utilities' Programs
10B	Participating home buyers and non-participating home buyers rank efficiency more highly on lists of desired home attributes	Higher	Yes	Moderate
10C	Participating home buyers and non-participating home buyers express greater willingness to pay the incremental costs	Higher	Yes	Moderate
11	***Increased home buyer demand for energy efficiency causes an increase in builder marketing of efficiency***			
11A	Participating builders and non-participating builders perceive an increase in home buyer demand for efficiency and therefore increase their marketing of it	Higher	Yes	High
11B	Number of builder ads and signs mentioning efficiency increases	Mixed	No	NA
12	***Increased home buyer demand for energy efficiency causes appraisers to assign value to efficiency and lenders to provide energy efficient mortgages (EEMs), which in turn increases home buyer demand***			
12A	Appraisers and lenders perceive an increase in home buyer demand for efficiency and, respectively, assign more value to it and make more EEMs available;	Lower	No	NA
12B	Home buyers are aware of appraisers assigning value to efficiency and lenders providing EEMs, which increases home buyer demand	Same	No	NA
13	***The decreased cost of energy-efficient technologies and practices encourages economies of scale and helps decrease their incremental cost beyond the amount of the incentive***			
13A	Manufacturers and builders report decreases over time in the incremental costs of energy-efficient technologies and practices	Lower	Yes	Moderate
14	***Increased economies of scale for energy-efficient technologies and practices leads to their adoption by an increasing number of builders***			
14A	Some participating builders and a few non-participating builders report decreasing incremental costs of energy-efficient technologies and practices as a factor encouraging their use	Higher	Yes	Moderate

Link/ Indicator number	*Theory* and Indicators	Change Observed	Change Consistent with Market and Program Theory	Likelihood Of Change Being Attributable To Utilities' Programs
14B	The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time	Higher	Yes	High
15	***The demonstration of feasibility of energy-efficient technologies and practices leads to their adoption by an increasing number of builders***			
15A	Participating builders and non-participating builders who are aware of IOUs' R&D and case studies are more likely than others to try the new technologies and practices	Mixed	No	NA
15B	The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time	Higher	Yes	High
16	***Increased knowledge about energy-efficient technologies and practices leads to their adoption by an increasing number of builders***			
16A	Some participating builders and a few non-participating builders who became knowledgeable about new energy-efficient technologies and practices (directly or indirectly) through IOUs' training are more likely than others to try the new technologies and practices	Higher	Yes	High
16B	The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time	Higher	Yes	High
17	***Increased builder marketing of efficiency by some builders leads other builders to adopt energy-efficient technologies and practices***			
17A	Non-participating builders who are aware of increased marketing of efficiency by other builders are more likely than others to try the new technologies and practices	Higher	Yes	High
17B	The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time	Higher	Yes	High

Link/ Indicator number	*Theory* and Indicators	Change Observed	Change Consistent with Market and Program Theory	Likelihood Of Change Being Attributable To Utilities' Programs
18	***Increased demand from home buyers for energy-efficient technologies and practices leads to their adoption by an increasing number of builders***			
18A	Some participating builders and a few non-participating builders report increasing home buyer demand for energy-efficient technologies and practices as a factor encouraging their use	Higher	Yes	Moderate
18B	The incidence of above-code energy-efficient technologies and practices observed in evaluators' on-site inspections of non-participating homes increases over time	Higher	Yes	High
19	***Enough builders are using energy-efficient technologies and practices such that the market is prepared for a code upgrade***			
19A	The incidence of energy-efficient technologies and practices, as observed in evaluators' on-site inspections of participating and non-participating homes, becomes a significant part of the market	Higher	Yes	High
19B	Key builders and industry experts indicate that there is enough knowledge and availability of efficient technologies and practices in the marketplace that the code could be upgraded and most builders could comply within a reasonable time	NA	Yes	Moderate
20	***Improved enforcement of the current code improves the least efficient end of the market and helps prepare the market for a code upgrade***			
20A	The incidence of code-compliant homes increases over time as observed in evaluators' on-site inspections	Higher	Yes	Moderate
20B	The incidence of compliance is higher in municipalities whose code officials have received PG&E-sponsored compliance training	NA	Yes	High
21	***The market proves ready and the code is upgraded***			
21A	Key builders and industry experts indicate that the IOUs' programs have contributed to market readiness for a code upgrade that has occurred or is planned, thus consolidating and ensuring the sustainability of efficiency gains	NA	Yes	Moderate

Link/ Indicator number	*Theory* and Indicators	Change Observed	Change Consistent with Market and Program Theory	Likelihood Of Change Being Attributable To Utilities' Programs
21B	Utility measures incentivized in the 2006-2008 programs are part of the 2008 code, or are in the draft language for the 2011 code.	NA	Yes	Moderate

6 Outline for Phase II

We will conduct Phase II of the study only if we determine in Task 2: Analysis of Market Effects (Part 1) that there are indeed market effects, and in Task 3: Assessment of Attribution in Phase I that these market effects can reasonably be attributed to the utilities' programs.

6.1 Development of Plan for Phase II

The tasks in Phase II are outlined in the *Final Study Plan*, but will be ultimately refined and determined by the Scoping Study and the findings of the Phase I analyses. The tasks outlined in the *Final Study Plan* are as follows:

1. Analysis of Market Effects (Phase II)
2. Assessment of Attribution (Phase II)
3. Assessment of Net Energy and Demand Savings
4. Assessment of Sustainability

At the beginning of Phase II—if it takes place—we will develop a plan for these four tasks, summarized at a high level in the sections below.

6.2 Analysis of Market Effects (Part 2)

Phase I of the study will provide a qualitative portrait of the evolution of actual RNC practices in California, and an assessment of market actors' judgment as to the role of the utilities' programs in these changes. Phase II will involve development of a hypothetical baseline, and a comparison of actual RNC practices to hypothetical baseline practices. An approach suggested in the Final Study Plan for establishing a baseline is to identify "a sub-sample of non-participant builders and homes for which there is a high degree of certainty that there was no effect from the utility programs." We will explore possible biases with this approach—including the likelihood that early adopters would not be in this group, but would have existed in a world without utility programs—and how this bias could be compensated for. We will also explore other options for creating a possible baseline, and, as part of Task 3 in Phase I, recommend an approach for constructing a hypothetical baseline during Phase II of the study.

6.3 Assessment of Attribution (Part 2)

As in Phase I of the study, this task in Phase II will involve a preponderance of evidence approach, using a wide range of sources to assess the degree to which utility programs have been responsible for the market effects identified. In part 2, additional evidence will include whether comparisons between actual and hypothetical baseline RNC practices show significant differences.

6.4 Estimation of Net Energy and Demand Savings

In this task, the project team will prepare a strategy for assessing net energy and demand savings attributable to the market effects of utility programs on RNC design and construction practices. The savings estimates will be generated based on an assessment of baseline and high efficiency construction characteristics and the spillover of those practices to the broader market of non-participating projects resulting from program activities. Building energy simulation modeling will be the tool of choice for the analysis. These models are data intensive and require specific inputs that are representative of the market conditions being analyzed. With this in mind, it is important that the data elements and overall market effects indicators that are needed to support the models and the analysis of market conditions be identified up front in the project and that the project team assures that these data elements and indicators are collected and managed over the course of the project. This planning task will be used to assure that these data elements and indicators are identified in Phase I and that the necessary data are collected and managed to support the analysis in Phase II.

6.5 Assessment of Sustainability

This task will involve assessing the extent to which the observed market effects could be expected to last into the future in the absence of utility programs. The Final Study Plan mentions the possibility using the approach developed in Massachusetts, answering the questions posed by Hewitt:[21]

- Is someone making money by offering it?
- Has a private market developed to continue its facilitation?
- Has the profession or trade adopted it as a standard practice?
- Would it be difficult or costly to revert to earlier equipment or practices?
- Are end-users requesting or demanding it?
- Have the risks to private market actors been reduced or removed?

The Massachusetts work referred to in the Final Study Plan was conducted by NMR, for homes, appliances, and lighting programs.[22] The RLW team will follow a similar approach for this study.

[21] Hewitt, D.C. 2000. "The Elements of Sustainability." In *Efficiency & Sustainability, Proceedings of the 2000 Summer Study on Energy Efficiency in Buildings*. Washington DC: American Council for an Energy-Efficient Economy. Pp. 6.179-6.190.

[22] For example, see Hoefgen, L., A. Li, and S. Feldman, "Asking the Tough Questions: Assessing the Transformation of Appliance Markets," in *Proceedings of the 2006 Summer Study on Energy Efficiency in Buildings*. Washington DC: American Council for an Energy-Efficient Economy. Pp. 10.14-10.25.

7 Schedule

Consistent with the project's requirements stated in the *Final Study Plan*, we present the schedule and deliverables below in two phases. The first phase will cover the initial scoping study (represented by this report), analysis of market effects, and assessment of attribution, resulting in a Draft Interim Report to be delivered by November 26, 2008.

Table 11: Phase I Schedule

(Tasks with deliverables shown in italics)

Task 1: Analysis of Market Evolution			2008
Task	1-1	Assess historic trends in RNC efficiency practices in California	August 1-September 30
	1-1-1	Conduct literature review of RNC studies and evaluation research	August 1-September 30
	1-1-2	*Report results of historic trends in RNC efficiency practices in California*	August 1-September 30
	1-2	*Assess historic trends in builders' awareness, attitudes and practices*	August 1-September 30
	1-3	*Assess historic trends in home buyer awareness and attitudes*	August 1-September 30
	1-4	*Assess historic trends in incremental costs of efficiency measures*	August 1-September 30
Task 2: Analysis of Market Effects, Part 1			
Task	2-1	Estimating the extent of spillover among non-participant builders	
	2-1-1	Builder Interviews and Additional On-Sites	August 4-October 10
	2-1-2	Market Actor Interviews	August 4-October 10
	2-1-3	Coordination with Marketing & Outreach Evaluation	August 4-October 10
	2-1-4	Assessing Consumer Demand	May 12-October 10
	2-1-5	*Analyzing and Documenting Spillover among Non-participant Builders*	October 20-31
	2-2	*Analyzing the cumulative impact of utility programs on codes & standards*	May 6-October 31
Task 3 / Task 3: Assessment of Attribution			November 1-26, 2008
DRAFT INTERIM PHASE I REPORT			November 26, 2008
FINAL PHASE I REPORT AND PRESENTATION TO CPUC			December 16, 2008

The work performed under Phase I of the Study will significantly inform the second phase—and in fact Phase II will be contingent on the findings from Phase I. Should Phase II take place, the RLW team will conclude research activities by September 18, 2009 and deliver a Draft Report by October 9, 2009.

Table 12: Phase II Schedule

(Tasks with deliverables shown in italics)

Development of Plan for Phase II	November 27-December 22, 2008
Analysis of Market Effects (Part 2)	December 23, 2008-May 15, 2009
Assessment of Attribution (Part 2)	May 18-June 19, 2009
Estimation of Net Energy and Demand Savings	May 18-August 14, 2009
Assessment of Sustainability	August 17-September 18, 2009
DRAFT PHASE II REPORT	October 9, 2009
FINAL PHASE II REPORT AND PRESENTATION TO CPUC	November 2, 2009

8 Budget

The approximate budget for Phase I is shown in Table 13.

Table 13: Phase I Budget

Work Plan Development			**$45,511**
Scoping Study			**$139,093**
Task 1: Analysis of Market Evolution			**$93,177**
Task	1-1	Assess historic trends in RNC efficiency practices in California	
	1-1-1	Conduct literature review of RNC studies and evaluation research	$20,162
	1-1-3	Report results of historic trends in RNC efficiency practices in California	$28,720
	1-2	Assess historic trends in builders' awareness, attitudes and practices	$12,584
	1-3	Assess historic trends in home buyer awareness and attitudes	$6,693
	1-4	Assess historic trends in incremental costs of efficiency measures	$11,005
	1-5	Assess historic trends in other key indicators identified in the program theories	$14,013
Task 2: Analysis of Market Effects, Part 1			**$211,711**
Task	2-1	Estimating the extent of spillover among non-participant builders	
	2-1-1	Builder interviews and additional on-sites	$94,169
	2-1-2	Market actor interviews	$45,681
	2-1-4	Coordination with Marketing & Outreach evaluation	$3,024
	2-1-5	Assessing consumer demand	$9,089
	2-1-6	Analyzing and documenting spillover among non-participant builders	$28,646
	2-2	Analyzing the cumulative impact of utility programs on codes & standards	$31,102
Task 3: Assessment of Attribution			**$17,482**
TOTAL BUDGET			**$506,974**

APPENDIX A: Summary of Previous Residential New Construction Market Effects Studies

Appendix A: Summary of Previous Residential New Construction Market Effects Studies

Report	Market Theory	Market Barriers	Market Actors	Definition of Market Effects and Indicators
1999 California Residential New Construction (RNC) Utility Program Comparison Study	Not defined in reviewed documents	▪ Information search costs ▪ Lack of product knowledge ▪ Asymmetric information (i.e., buyer distrust of vendor information and motives) ▪ Market uncertainties ▪ Performance Uncertainties ▪ Perceived low value of energy efficiency ▪ High capital costs ▪ Focus of some supply side actors too narrow, preventing the exploration of alternative solutions ▪ Organizational practices ▪ Transaction costs ▪ Hidden costs ▪ Split incentives ▪ Bounded rationality (i.e., behavior inconsistent with goals or self-interest) ▪ Access to financing; appraisers and lenders do not account for energy efficiency ▪ Title 24 ▪ Irreversibility ▪ Unavailability (real or perceived)	▪ Builders ▪ Homebuyers ▪ Architect/designers ▪ HVAC contractors ▪ Realtors/sales agents ▪ Lenders ▪ Appraisers ▪ Title 24 consultants	Increased awareness, knowledge, and valuation of energy efficiency and increased intentions and actions to adopt energy efficiency by market actors due to program activities.

Report	Market Theory	Market Barriers	Market Actors	Definition of Market Effects and Indicators
1998 PG&E Comfort Home Program Market Baseline And Market Effects Study. PG&E Study ID #420ms-e June 30, 1999. Prepared by Regional Economic Research, Inc.	▪ The RNC market consists of the new home market and two ancillary markets: the equipment and shell measure market and the contractor services market. ▪ The new home market is the dominant sub-market in RNC. Builders and those directly involved in the design and construction of the new home play the dominant supply side role and homebuyers play the demand side role.	▪ Asymmetric information ▪ Product unavailability ▪ Performance uncertainties ▪ Access to financing ▪ Split incentives ▪ Organizational practices	▪ Builders ▪ Homebuyers ▪ Manufacturers (window and HVAC) ▪ Distributors ▪ Contractors ▪ Title 24 Consultants ▪ Architects ▪ Lenders ▪ Sales agents ▪ Building inspectors ▪ Government agency and non-government representatives	Market effects are defined as the potential effects of specific program interventions to reduce key market barriers and the assessment of the sustainability of these effects. Key indicators include: ▪ Increased awareness of energy efficiency ▪ Increased knowledge of energy efficiency ▪ Increased valuation of energy efficiency ▪ Increased intentions to adopt energy efficiency ▪ Increased adoption of energy efficiency

Report	Market Theory	Market Barriers	Market Actors	Definition of Market Effects and Indicators
Pacific Gas and Electric' Time of Sale Energy Renovation (TOSER) Program	Market theory for why homebuyers do not make extensive energy efficient improvements when they purchase an existing home. ▪ Homebuyers are unaware of the energy efficiency and utility bills of the existing home ▪ Homebuyers are unaware or doubtful about how much the efficiency level could be improved and the benefits they would enjoy ▪ Homebuyers lack knowledge to make efficiency improvements ▪ Homebuyers expect the added costs to be high ▪ Financing is not readily available for efficiency improvements ▪ Homebuyers are concerned that making the improvements would delay closing on the transaction. ▪ Lack of knowledge about and support for energy efficient mortgages (EEMs) from lenders and real estate agents	Market barriers for Energy Efficient Mortgages (EEMs) include: ▪ Lenders are not fully aware of or knowledgeable about EEMs and lenders often view an EEM as a complication of the lending process. ▪ Real estate agents are not very aware of EEMs and fear that EEMs can interfere with the orderly home sale/purchase transaction. ▪ Buyers are generally unaware of, uninterested in, and lack knowledge about EEMs and often find the process complicated. ▪ The home energy rating process can be perceived to be relatively costly.	▪ Lenders ▪ Real Estate Agents ▪ Homebuyers ▪ Home Energy Rating services ▪ Home loan consultants	Market effects for EEMs (not overall market for residential efficiency improvements): direct effects on program participants (lenders, real estate agents, and homebuyers) and non-participant spillover.

Program	Market Theory	Market Barriers	Market Actors	Definition of Market Effects and Indicators
Massachusetts ENERGY STAR® Homes Program	▪ Home buyers do not demand energy-efficient new homes (because they do not adequately understand energy efficiency and energy costs, they have no signal or way to gauge the costs, and so there is no incentive to invest in energy efficiency); ▪ Few builders have any incentive to offer energy-efficient new homes (because there is no demand from buyers); ▪ Many builders therefore lack information as to what constitutes energy-efficiency in homes. ▪ In turn, home raters and building consultants have experienced little demand for their services	▪ Split incentives: builders make efficiency decisions but consumers pay utility bills ▪ Lack of homebuyer and builder awareness of full range of benefits of energy efficient homes ▪ Limited technical skill ▪ Inability to identify efficiency	▪ Builders ▪ Home buyers ▪ Real estate agents ▪ Appraisers ▪ Lenders ▪ Subcontractors (HVAC, insulators) ▪ Developers ▪ Manufacturers (HVAC, insulation) ▪ Distributors ▪ Architects ▪ Code enforcers ▪ HERS raters	Market Effects are defined as participant and non-participant spillover for builders and home buyers
LIPA New York ENERGY STAR® Labeled Homes Program	Not defined in reviewed documents	▪ Split incentives: builders make efficiency decisions but consumers pay utility bills ▪ Lack of homebuyer and builder awareness of full range of benefits of energy efficient homes ▪ Lack of demand for energy efficient homes and appliances ▪ Lack of geographic and housing type variety that meets ENERGY STAR standards ▪ Lack of financing for energy efficient homes ▪ Limited technical skill ▪ Lack of awareness of renewable technologies and applications ▪ Lack of marketing skills to sell	▪ Builders ▪ Home buyers ▪ New York Department of State, Codes Division (DOS) ▪ Subcontractors (HVAC, insulators) ▪ HERS raters ▪ Real estate agents ▪ Lenders ▪ Trade Associations ▪ Manufacturers (HVAC, insulation) ▪ Distributors	Participant and non-participant spillover for builders, home buyers, distributors and manufacturers

Program	Market Theory	Market Barriers	Market Actors	Definition of Market Effects and Indicators
		efficiency ▪ Inability to identify efficiency ▪ High incremental costs for high efficiency equipment and low volume of distribution of high efficiency equipment		
Efficiency Vermont's Residential New Construction (RNC) Program	Not defined in reviewed documents	▪ Lack of homebuyer and builder awareness of full range of benefits of energy efficient homes ▪ Lack of awareness and compliance with the Vermont Residential Building Efficiency Standard; ▪ Low demand for Home Energy Ratings (HERS) ▪ Lack of mortgages that account for the benefits for energy-efficient homes.	▪ Builders ▪ Home buyers ▪ HVAC and other trades contractors ▪ Home energy rating services ▪ Industry associations ▪ Lenders	Attribution of adoption of efficient building practices to program influence (participant and non-participant spillover)
Wisconsin ENERGY STAR Homes Program	▪ New homebuyers either cannot or will not identify newly constructed homes with energy efficiency characteristics that are superior to code. ▪ No incentive for sellers to build or promote energy efficient homes ▪ Lack of home buyer information can be addressed by developing a new, widely recognized, standard level of efficiency that is higher than code, thereby making it easier for customers to identify energy efficient houses. ▪ Developing an energy efficiency standard requires intervention at all market levels (e.g., customer	▪ Lack of homebuyer ability or interest in identifying energy efficient homes ▪ Lack of incentive for builders to build or promote energy efficient homes. This includes the incremental costs to builders, such as increased time for paperwork and inspections, that cannot be readily included in the price of the home ▪ Builder reluctance to change construction practices ▪ Builder objections to and misperceptions about energy efficient building practices ▪ Low demand for Home Performance Raters	▪ Builders ▪ Subcontractors ▪ Home Performance Raters ▪ Home buyers ▪ Architects	Participant an non-participant spillover (builder, subcontractor, home performance rater, homebuyer)

Program	Market Theory	Market Barriers	Market Actors	Definition of Market Effects and Indicators
	education and advertising, builder education and training, and building science expert development and training).			
Northwest Energy Efficiency Alliance's ENERGY STAR Homes Northwest program	▪ Home buyers do not demand energy-efficient new homes (because they do not adequately understand energy efficiency and energy costs, they have no signal or way to gauge the costs, and so there is no incentive to invest in energy efficiency); ▪ Few builders have any incentive to offer energy-efficient new homes or use energy efficiency to differentiate their homes (because there is no demand from buyers)	▪ Split incentives: builders make efficiency decisions but consumers pay utility bills ▪ Lack of homebuyer and builder awareness of full range of benefits of energy efficient homes ▪ Inability of homebuyers to identify efficiency ▪ Inability of builders, consumers, and other market actors to identify the magnitude and potential value of energy savings that can result from improved construction practices. ▪ Limited technical skill ▪ Economic benefits of energy efficiency are not readily recognized by financial markets. Appraisers rarely value energy efficiency improvements or benefits, and most mortgage lenders do not distinguish between efficient and inefficient homes	▪ Builders ▪ Homebuyers ▪ Appraisers ▪ Lenders ▪ Real estate agents ▪ HVAC contractors ▪ Lighting distributors	Not defined in reviewed documents
Energy Trust of Oregon's Efficient New Homes Program	Not defined in reviewed documents	▪ Builder perceptions of incremental costs of energy efficiency ▪ Builder perception of time required to participate in program ▪ Builder perception of homebuyer willingness to pay for energy efficiency	▪ Builders ▪ Homebuyers ▪ Verifiers ▪ Energy Trust of Oregon (ETO) ▪ Northwest Energy Efficiency Alliance	

Program	Market Theory	Market Barriers	Market Actors	Definition of Market Effects and Indicators
		▪ Builder reluctance to pay for home testing and verification ▪ Relative importance of energy efficiency in purchase decision by homebuyer ▪ Builder and subcontractor reluctance to change construction practices ▪ Perceptions of ENERGY STAR relative to other energy and building programs ▪	(NEEA) ▪ Utilities ▪ Real estate agents ▪ HVAC installers and other subcontractors ▪ Equipment trade allies ▪ Portland Energy Conservation, Inc. (PECI)	
Massachusetts ENERGY STAR® Homes Program	▪ Home buyers do not demand energy-efficient new homes (because they do not adequately understand energy efficiency and energy costs, they have no signal or way to gauge the costs, and so there is no incentive to invest in energy efficiency); ▪ Few builders have any incentive to offer energy-efficient new homes (because there is no demand from buyers); ▪ Many builders therefore lack information as to what constitutes energy-efficiency in homes. ▪ In turn, home raters and building consultants have experienced little demand for their services	▪ Split incentives: builders make efficiency decisions but consumers pay utility bills ▪ Lack of homebuyer and builder awareness of full range of benefits of energy efficient homes ▪ Limited technical skill ▪ Inability to identify efficiency	▪ Builders ▪ Home buyers ▪ Real estate agents ▪ Appraisers ▪ Lenders ▪ Subcontractors (HVAC, insulators) ▪ Developers ▪ Manufacturers (HVAC, insulation) ▪ Distributors ▪ Architects ▪ Code enforcers ▪ HERS raters	Market Effects are defined as participant and non-participant spillover for builders and home buyers

APPENDIX B: Utility Program Manager Interview Guide

Staff Interview Guide for IOU RNC Codes & Standards Programs—Market Effects (May 14, 2008)

Interviewer:

Date:

Subject Name:

Organization:

Program(s) responsible for:

Hello, my name is _____ from Nexus Market Research. I'm conducting interviews for the Residential New Construction Market Effects Evaluation Team, under a contract with the CPUC. Do you have some time to discuss the residential [new construction /codes and standards] program that you administer? Our conversation should last about an hour. [IF YES CONTINUE; IF NO:] Is there a more appropriate time that we could schedule for this conversation? [RECORD TIME]

[IF INTERVIEWEE ASKS ABOUT THE STUDY'S SPONSORSHIP, REFER TO AYAT OSMAN, CPUC, AT (415) 703-5953]

Roles and Responsibilities

1. First, I just want to verify that you work on [PROGRAM/S]. Is that correct?

2. How long have you been working on [PROGRAM/S]? How long have you worked for [UTILITY]?

3. What is your specific role with [PROGRAM/S]?

4. Is there an implementation contractor for [PROGRAM/S]? [IF YES] Who is it, and what are the responsibilities the implementation contractor?

5. Who were the major participants and individuals engaged in the program design process? Over what period did the program design process occur? [IF DESIGNED INTERNALLY] Did the program rely on any outsiders for program design assistance? [IF YES] Who, and what was their role?

Understanding of the Market

6. From your perspective, who are the key market actors in the residential new construction market [e.g., builders, subcontractors, suppliers, architects/engineers, realtors, Title 24 consultants, etc.]? Could you describe your understanding of the roles of each of these market actor groups? Do you know if these groups interact with one another, or are do they act separately from one another? Are their key figures that people look to in each of these groups – for example, is there a major builder/developer that other builders/developers follow or monitor? And does your program work with all of these market actor groups? Equally or do you spend more time with one or more market actor groups? If the latter, which ones?

7. Who do you think typically makes decisions about efficiency for new homes? What factors do they consider? How does it vary by geography/climate, spec vs. custom, price of the house, etc.? Have the ways decisions about efficiency are made changed over the years?

8. What are the key market barriers to effecting greater efficiency in residential new construction? [PROBES: market actor group, technology/equipment, building practices, geography/climate] And does your program address all of these market barriers? Equally or do you spend more time addressing one or more market barriers? If the latter, which ones?

9. What are the key drivers to greater efficiency in residential new construction? [PROBES: market actor group, technology/equipment, building practices, geography/climate]

10. How has efficiency in residential new construction been affected by the housing boom in earlier years? The recent housing slump? Are there any other important external influences?

11. Do you have an explicit market theory about how the market operates—that is, not a theory about the program, but the market itself? How can we get a copy?

Program Background

12. What is the overall, primary goal of the program? How will you know when this goal has been achieved?

13. How is the program coordinated with those of the other IOUs? Municipal utilities?

14. What is the program process? Is there an explicit process flow diagram? How can we get a copy?

15. Are there any other program planning documents other than the Program Implementation Plan and associated files in the EEGA website? How can we get a copy?

16. What are the program's activities—that is, what does the program do? [PROBES: market actor group, technology/equipment, behavior, installation practice] What are the outputs of these activities—the immediate, tangible results they are meant to achieve? [e.g., an output of training would be number of builders or subcontractors trained in a particular building practice]

17. How have program activities changed over the years? Have you made these program changes in response to changes in the market, or for other reasons?

18. How are program accomplishments being tracked?

Program Theory

19. Is there an explicit program theory for this program? [By "program theory" I mean a description of how and why the program is supposed to achieve the desired results.] How can we get a copy?

20. How about a logic model?

[IF Q#19 OR Q#20 DOCUMENTS EXIST, SKIP TO Q#26; OTHERWISE CONTINUE]

21. How are program activities [REFER TO RESPONSES TO Q.#16] designed to address the barriers to efficiency you mentioned earlier? [REFER TO RESPONSES TO Q.#8]

22. What are the motivations for program participation, by market actor type?

23. I'm going to ask you about the short-, medium- and long-term outcomes you expect the program to achieve, but first could you define short, medium and long term?

24. What are the short-, medium- and long-term outcomes you expect the program to achieve? [FOR EACH OUTCOME] How do you expect program activities to lead to this outcome?

25. [FOR EACH OUTCOME] For each of the outcomes you mentioned previously, what are the indicators of these outcomes—how could one surmise that a given outcome is being achieved?

26. Overall, how do you envision the program having an impact on the broader residential new construction market—including non-participants—and helping to transform the market? How far along is the market on the path to transformation?

27. What would happen to the market if your program ended now? Why do you say that?

Other Sources

28. Have there been any recent market studies? Impact evaluations? Process evaluations? How about drafts—not for attribution?
29. Are there any other sources of information that could help us understand the market, or your program?

30. Can you think of any experts on the residential new construction market who could help answer some of the questions we've been asking you? [GET NAMES, AFFILIATIONS, AND CONTACT INFORMATION]

31. [MAKE SURE TO GET NAMES, AFFILIATIONS, AND CONTACT INFORMATION FROM Q.#4 AND Q.#5]

32. Finally, if we have any further questions would it be okay to call you back for clarification?

THANKS VERY MUCH!

APPENDIX C: Industry Expert Interview Guide

Industry Expert Interview Guide for IOU RNC Codes & Standards Programs—Market Effects (May 12, 2008)

Interviewer:

Date:

Subject Name:

Organization:

Program(s) responsible for:

Hello, my name is _____ from Nexus Market Research. I'm conducting interviews for the Residential New Construction Market Effects Evaluation Team, under a contract with the CPUC. Do you have some time to discuss the residential new construction market and California utilities' residential new construction programs? Our conversation should last about 30 minutes. [IF YES CONTINUE; IF NO:] Is there a more appropriate time that we could schedule for this conversation? [RECORD TIME]

[IF INTERVIEWEE ASKS ABOUT THE STUDY'S SPONSORSHIP, REFER TO AYAT OSMAN, CPUC, AT (415) 703-5953]

Roles and Responsibilities

1. What is your role with respect to California utilities' residential new construction programs?

Understanding of the Market

2. From your perspective, who are the key market actors in the residential new construction market [e.g., builders, subcontractors, suppliers, architects/engineers, realtors, Title 24 consultants, etc.]? Could you describe your understanding of the roles of each of these market actor groups? Do you know if these groups interact with one another, or are do they act separately from one another? Are their key figures that people look to in each of these groups – for example, is there a major builder/developer that other builders/developers follow or monitor?

3. Who do you think typically makes decisions about efficiency for new homes? What factors do they consider? How does it vary by geography/climate, spec vs. custom, price of the house, etc.? Have the ways decisions about efficiency are made changed over the years?

4. What are the key market barriers to effecting greater efficiency in residential new construction? [PROBES: market actor group, technology/equipment, building practices, geography/climate] And do the utility new construction programs address all of these market barriers? Equally or do the programs spend more time addressing one or more market barriers? If the latter, which ones?

5. What are the key drivers to greater efficiency in residential new construction? [PROBES: market actor group, technology/equipment, building practices, geography/climate]

6. How has efficiency in residential new construction been affected by the housing boom in earlier years? The recent housing slump? Are there any other important external influences?

Program Theory

7. Overall, how do you envision the California utilities' residential new construction programs having an impact on the broader residential new construction market—including non-participants—and helping to transform the market? How far along is the market on the path to transformation?

8. What would happen to the market if the programs ended now? Why do you say that?

Other Sources

9. Can you think of any experts on the residential new construction market who could help answer some of the questions we've been asking you? [GET NAMES, AFFILIATIONS, AND CONTACT INFORMATION]

10. Finally, if we have any further questions would it be okay to call you back for clarification?

THANKS VERY MUCH!

APPENDIX D: Market Effects Questions Included in the NC/CS Non-participant Home Buyer Survey

RESIDENTIAL NEW CONSTRUCTION Phone Survey
FOR PROGRAM YEARS 2006/2008

HomeType

0	NonParticipant Home
1	Known Participant Home - Full Inspect & Meter
2	Known Participant Home - Verify Only
3	Known Participant Home - MF - Verify Only

OUTCOME1 Hello, this is <INTERVIEWER NAME> calling on behalf of Itron. We are conducting a fact-finding survey only, authorized by the California Public Utilities Commission. This survey is part of an effort to gather information on the energy efficient characteristics of new homes built in California.

[IF NEEDED] This is not a sales call.

SCREENER

Scrn_Addr Our records show your home is located at &ADDRESS in &CITY &ZIP. Is that correct?

[CONTINUE IF ADDRESS REPORTED BY RESPONDENT IS SIMILAR ENOUGH]

1	Yes	SC1
2	No	CORRECT
88	Refused	T&T
99	Don't know	T&T

CORRECT May I have your correct address?

&CORRECT	Corrected Address	SC1

S1 Our records show that the home you are currently living in was built after January 2006. Is this true?

1	Yes	S2
2	No	S2

88	Don't Know	T&T
99	Refused	T&T

S2 In which year was the home that you are currently living in built?

1	Prior to 2006	T&T
2	2006	S2b
3	2007	S2b
4	2008	S2b
88	Refused	T&T
99	Don’t know	T&T

S2b In which month was construction completed? [IF NEEDED] If you do not know the month, the season will be fine.

1	January	Scrn_Addr
2	February	Scrn_Addr
3	March	Scrn_Addr
4	April	Scrn_Addr
5	May	Scrn_Addr
6	June	Scrn_Addr
7	July	Scrn_Addr
8	August	Scrn_Addr
9	September	Scrn_Addr
10	October	Scrn_Addr
11	November	Scrn_Addr
12	December	Scrn_Addr
13	Fall	Scrn_Addr
14	Winter	Scrn_Addr
15	Spring	Scrn_Addr
16	Summer	Scrn_Addr
88	Refused	Scrn_Addr
99	Don’t know	Scrn_Addr

SITE CHARACTERISTICS

SC1 What type of residence do you currently reside in? [READ]

1	Tract-built detached single family home	SC1_SFA
2	Custom built detached single family home	SC1_SFA
3	Attached single family (Duplex/Townhouse)	SC2
4	Condo or Apartment (Multifamily unit)	Check1
5	Mobile Home	T&T
77	Other	SC1_MF
88	Don't Know	SC1_MF
99	Refused	SC1_MF

Check1 **If &HomeType < 2 and SC1 = 4 then T&T**

If SC1 > 6 then Probe

SC1_MF Does anyone in your building live directly above or directly below you?

1	Yes	Check2
2	No	SC1_SFA
88	Don't Know	T&T
99	Refused	T&T

Check2 **If &HomeType < 2 and SC1_MF = 1 then T&T**

SC1_SFA Do any walls of your residence touch the walls of another residence?

1	Yes	SC1_MH
2	No	SC1_MH
88	Don't Know	SC1_MH
99	Refused	SC1_MH

SC1_MH Is your home a manufactured home? [IF NEEDED] Was your home installed on the lot already built?

1	Yes	T&T

2	No	SC2
88	Don't Know	SC2
99	Refused	SC2

SC2 Do you own or rent this residence?

1	Own	SC3
2	Rent	SC3
88	Refused	SC3
99	Don't know	SC3

SC3 In which year did you move into your current residence?

1	Prior to 2006	T&T
2	2006	SC3b
3	2007	SC3b
4	2008	SC3b
88	Refused	SC3b
99	Don't know	SC3b

SC3b In which month did you move into your current residence? [IF NEEDED] If you do not know the month, the season will be fine.

1	January	SC4
2	February	SC4
3	March	SC4
4	April	SC4
5	May	SC4
6	June	SC4
7	July	SC4
8	August	SC4
9	September	SC4
10	October	SC4
11	November	SC4
12	December	SC4

13	Fall	SC4
14	Winter	SC4
15	Spring	SC4
16	Summer	SC4
88	Refused	SC4
99	Don't know	SC4

SC4 What was the name of the home builder?

1	Anderson Homes	SC5
2	Beazer	SC5
3	Brookfield Homes	SC5
4	Castle & Cooke	SC5
5	Cornerstone Communities	SC5
6	D.R. Horton	SC5
7	Dan Winklebleck	SC5
8	Grupe Compnany	SC5
9	John Lang	SC5
10	KB	SC5
11	Lennar	SC5
12	McCaffrey Group	SC5
13	New Land Communities	SC5
14	Pardee	SC5
15	Pulte Homes	SC5
16	Raymus Homes	SC5
17	Ryland	SC5
18	SCM Homes	SC5
19	Shea	SC5
20	Standard Pacific Homes	SC5
21	Trimark Pacific	SC5
22	Vanguard	SC5
23	Wathen-Castanos	SC5

24	William Lyon Homes	SC5
77	Other	SC5
88	Don't Know	SC5
99	Refused	SC5

SC5 What is the name of the subdivision or development complex where your current residence is located?

1	Subdivision [RECORD VERBATIM]	SC6
66	N/A	SC6
88	Don't Know	SC6
99	Refused	SC6

SC6 How many stories tall is the residence, including the basement?

1	1	SC8
2	2	SC7
3	3	SC7
4	4	SC7
88	Don't Know	SC7
99	Refused	SC7

SC7 Does the residence have a split level or split foyer?

1	Split Level Only	SC8
2	Split Foyer Only	SC8
3	Both	SC8
4	No	SC8
88	Don't Know	SC8
99	Refused	SC8

SC8 About how large is your home in terms of total square feet?

1	Square feet	SC9
88	Don't know	SC8a
99	Refused	SC8a

SC8a Is it …. [READ RANGE]?

1	less than 500 square feet	SC9
2	500-999 square feet	SC9
3	1,000 to 1,499 square feet	SC9
4	1,500-1,999 square feet	SC9
5	2,000-2,499 square feet	SC9
6	2,500-2,999 square feet	SC9
7	3,000-3,499 square feet	SC9
8	3,500-3,999 square feet	SC9
9	4,000 or more square feet	SC9
88	Don't know	SC9
99	Refused	SC9

SC9 Do you have central air conditioner in you home?

1	Yes	SC9a
2	No	SC10
88	Don't Know	SC10
99	Refused	SC10

SC9a How many central air conditioning units does you residence have?

1	1	SC10
2	2	SC10
3	3	SC10
88	Don't Know	SC10
99	Refused	SC10

SC10 Does your residence have any ceiling fans?

1	Yes	SC10a
2	No	SC11
88	Don't Know	SC11
99	Refused	SC11

Ask if SC10 = 1

SC10a Were the ceiling fans installed by the builder?

1	Builder	SC11
2	Home owner	SC11
3	Me	SC11
77	Other	SC11
88	Don't Know	SC11
99	Refused	SC11

SC11 Do you have a clothes washer and dryer in your residence?

1	Yes, both	SC11a
2	Only a clothes washer	SC11a
3	No	SC13
77	Other	SC12
88	Don't Know	SC12
99	Refused	SC12

Ask If SC11 = 1 or 2

SC11a Were they new or used when you moved in?

1	New	SC11b
2	Used	SC11b
77	Other	SC11b
88	Don't Know	SC11b
99	Refused	SC11b

Ask If SC11a = 1

SC11b Were they provided by the home builder or did you purchase them?

1	New by home builder	SC13
2	New by home owner	SC13
3	Used	SC13
66	N/A	SC13
77	Other	SC13

88	Don't Know	SC13
99	Refused	SC13

SC13 How about your refrigetator? Was it provided new by the home builder, did you purchase it new, or was it used?

1	New by home builder	SC14
2	New by home owner	SC14
3	Used	SC14
77	Other	SC14
88	Don't Know	SC14
99	Refused	SC14

SC14 Does your house have a spa?

1	Yes	SC15
2	No	SC15
77	Other	SC15
88	Don't Know	SC15
99	Refused	SC15

SC15 Does your house have a photovoltaic system? [IF NEEDED Does your house have solar panels that provide energy to the house, not just water heating or pool heating?]

1	Yes	SC16
2	No	SC16
77	Other	SC16
88	Don't Know	SC16
99	Refused	SC16

SC16 Does your house have an instantaneous water heater? [IF NEEDED Is you water heater tankless?]

1	Yes	AW031
2	No	AW031
77	Other	AW031
88	Don't Know	AW031

99	Refused	AW031

Market Effects

AW031 Based on what you may have seen or heard, are most new homes in your area and price range about as energy-efficient as they can be, or are there ways they could be built more energy-efficient?

1	Most new homes about as EE as they can be	AW030
2	New homes could be more energy-efficient	AW030
77	Other	AW030
88	Don't Know	AW030
99	Refused	AW030

AW030 Based on what you may have seen or heard, would you say that most new homes in your area and price range have about the same level of energy efficiency overall, or are there some new homes that are more energy-efficient than others?

1	Most new homes same/similar level of energy efficiency	New28
2	Some new homes more energy-efficient than others	New28
77	Other	New28
88	Don't Know	New28
99	Refused	New28

New28 Would you say that your home is more efficient, less efficient or about the same as other new homes?

1	More efficient	MA1
2	Less efficient	MA1
3	About the same	MA1
77	Other	MA1
88	Don't Know	MA1
99	Refused	MA1

New27 According to you, what would make a home energy efficient? [ACCEPT MULTIPLE] [DO NOT READ]

1	More or better insulation	PE049

2	More efficient central air conditioning	PE049
3	More efficient furnace or boiler/heating system	PE049
4	Better ductwork	PE049
5	Better sealing of air leaks	PE049
6	More efficient appliances	PE049
7	More efficient lighting	PE049
8	More efficient windows	PE049
9	Better framing materials	PE049
11	A higher level of efficiency for the house as a whole	PE049
12	Higher quality construction in general	PE049
13	Homes is tested to verify its energy efficiency	PE049
15	Lower utility bills	PE049
16	ENERGY STAR label	PE049
17	Other Government/Utility Program	PE049
18	High HERS rating	PE049
77	Other	RN024
88	Don't Know	RN024
99	Refused	RN024

Ask only if SC2 = 1, else skip to

MA1 Which of the following best describes how you purchased your home?

1	Purchased land and worked with an architect and/or builder to design.	RN014
2	Had a house plan and a lot and hired a contractor/builder to build the home.	RN014
3	Purchased a lot from a builder, selected one of several house plans offered by the builder and selected from various available upgrade options.	RN014
4	Purchased a home that was under construction and selected from various available upgrade options.	RN014
5	Purchased a finished home.	RN014
77	Other	RN014
88	Don't Know	RN014
99	Refused	RN014

New26 How influential would you say each of the following was on the decisions you made about the features of the home you bought or built? Please give me a 0 to 10 rating, where 0 is not influential at all, and 10 is extremely influential. [RANDOMIZE LIST]

Influ_P	Friends/Family/Neighbors/Co-Workers	RN015
Influ_M	Media	RN015
Influ_S	Model Home Salesperson	RN015
Influ_H	Home Show	RN015
Influ_U	Utility Representative or Literature	RN015
77	Other [SPECIFY:_____]	RN015
88	Don't Know	RN015
99	Refused	RN015

RN014 On a scale from 0 to 10, where 0 is not at all important and 10 is extremely important, how important was energy efficiency to you in the selection of this home?

#	0 - 10	RN024
77	Other	RN024
88	Don't Know	RN024
99	Refused	RN024

RN024 Were there any people, media outlets, or advertisements that actively emphasized the topic of energy efficiency when you were shopping for or building your home?

1	Yes	RN024a
2	No	New26
88	Don't Know	New26
99	Refused	New26

RN024a What were the contacts or information sources? [DO NOT READ] [ALLOW MULT]

1	Friends/Family/Neighbors/Co-Workers	New26
2	Media	New26
3	Model Home Salesperson	New26
4	Home Show	New26
5	Utility Representative or Literature	New26

77	Other [SPECIFY:_____]	New26
88	Don't Know	New26
99	Refused	New26

RN015 Some government agencies and utilities sponsor programs that are designed to encourage the installation of energy-efficient features in new homes. Have you heard of any government-sponsored or utility-sponsored programs like these?

1	Yes, aware of government- or utility-sponsored programs	RN016
2	No, not aware of programs	RN017_1
77	Other	RN017_1
88	Don't Know	RN017_1
99	Refused	RN017_1

RN016 What program names can you recall, if any? [DO NOT READ] [ACCEPT MULT]

1	Energy Star / Energy Star Homes Program	RN017_1
2	PG&E/Pacific Gas & Electric – Residential New Construction Program or other/unspecified program	RN017_1
3	SCE/Southern California Edison – New Homes Program or other/unspecified program	RN017_1
4	SoCalGas – Advanced Home Program or other/unspecified program	RN017_1
5	SDG&E/San Diego Gas & Electric – Advanced Home Program or other/unspecified program	RN017_1
6	EPA/DOE/US Gov't - other/unspecified program	RN017_1
77	Other	RN017_1
88	Don't know	RN017_1
99	Refused	RN017_1

Set &PrgmKnown = first mentioned

RN017_1 Ask if RM016_1 = 0
Have you heard of the Energy Star Homes Program that encourages installation of energy-efficient features in new homes?

1	Yes	RN017_2
2	No	RN017_2
88	Don't know	RN017_2
99	Refused	RN017_2

Ask if RM016_2 = 0 and PGE = 1

RN017_2 Have you heard of the PG&E Residential New Construction Program that encourages installation of energy-efficient features in new homes?

1	Yes	RN017_3
2	No	RN017_3
88	Don't know	RN017_3
99	Refused	RN017_3

Ask if RM016_3 = 0 and SCE = 1

RN017_3 Have you heard of the Southern California Edison New Homes Program that encourages installation of energy-efficient features in new homes?

1	Yes	RN017_4
2	No	RN017_4
88	Don't know	RN017_4
99	Refused	RN017_4

Ask if RM016_4 = 0 and SCG = 1

RN017_4 Have you heard of the SoCalGas Advanced Home Program that encourages installation of energy-efficient features in new homes?

1	Yes	RN017_5
2	No	RN017_5
88	Don't know	RN017_5
99	Refused	RN017_5

Ask if RM016_5 = 0 and SDGE = 1

RN017_5 Have you heard of the San Diego Gas & Electric Advanced Home Program that encourages installation of energy-efficient features in new homes?

1	Yes	RN017_6
2	No	RN017_6
88	Don't know	RN017_6
99	Refused	RN017_6

Ask All

RN017_6 Have you heard of the New Home Energy Savers Program that encourages installation of energy-efficient features in new homes?

1	Yes	RN20
2	No	RN20
88	Don't know	RN20
99	Refused	RN20

If &PrgmKnown = null then skip to PE049

RN20 As far as you know, was your home built under any of the programs mentioned above?

1	Yes, Energy Star Homes Program	RN021
2	Yes, PG&E Residential New Construction Program	RN021
3	Yes, Edison New Homes Program	RN021
4	Yes, SoCalGas Advanced Home Program	RN021
5	Yes, SDG&E Advanced Home Program	RN021
6	Yes, New Home Energy Savers Program	RN021
7	No, home not built under any programs	RN018
77	Other	RN018
88	Don't Know	RN018
99	Refused	RN018

Set &PrgmBuilt = 1 to 6

Ask if RN20 < 7, else skip to RN018

RN021 How important was this program sponsorship in your decision to purchase or build this home? Please give me a 0 to 10 rating, where 0 is not at all important, and 10 is extremely important. [ASK ONLY ONCE FOR ALL PROGRAMS]

#	0 - 10	RN018
77	Other [SPECIFY:_____]	RN018
88	Don't Know	RN018
99	Refused	RN018

From here on, I will refer to &PrgmBuilt as the Program.

RN018 Were you familiar with the Program before you first viewed your new home or first saw the plans?

1	Yes	MA46
2	No	MA46
77	Other	MA46
88	Don't Know	MA46
99	Refused	MA46

MA46 Did you seek out information about the Program when you were making your plans for building or buying a home?

1	Yes	MA47
2	No	MA48
77	Other	MA48
88	Don't Know	MA48
99	Refused	MA48

MA47 Who did you ask about the program? [DO NOT READ]

1	Architect/designer(s)	MA48
2	Builder(s) / builder or development sales agents	MA48
3	Home inspector (buyer's inspector)	MA48
4	Lenders	MA48
5	Realtors	MA48
6	Family	MA48
7	Friends	MA48
8	Neighbors	MA48
9	Work colleagues	MA48
10	Utility representatives	MA48
11	Web	MA48
77	Other	MA48
88	Don't Know	MA48
99	Refused	MA48

MA48 Did anyone mention the program when you were making your plans for building or buying a home?

1	Yes	New49
2	No	PE049
88	Don't Know	PE049
99	Refused	PE049

New49 Who brought up the subject of the program? [DO NOT READ]

1	Architect/designer(s)	MA50
2	Builder(s) / builder or development sales agents	MA50
3	Home inspector (buyer's inspector)	MA50
4	Lenders	MA50
5	Realtors	MA50
6	Family/Friends/Neighbors/Work Colleagues	MA50
7	Utility representatives	MA50
77	Other	MA50
88	Don't Know	MA50
99	Refused	MA50

MA50 What did they tell you about homes built under the program? [PROBE FOR SPECIFICS; DO NOT READ RESPONSES; MULTIPLE RESPONSE]

1	More or better insulation	PE049
2	More efficient central air conditioning	PE049
3	More efficient furnace or boiler/heating system	PE049
4	Better ductwork	PE049
5	Better sealing of air leaks	PE049
6	More efficient appliances	PE049
7	More efficient lighting	PE049
8	More efficient windows	PE049
9	Better framing materials	PE049
10	Utility representatives	PE049
11	Better comfort/fewer drafts	PE049

12	A higher level of efficiency for the house as a whole	PE049
13	Higher quality construction in general	PE049
14	No better than other homes—all new homes are energy efficient	PE049
15	Homes is tested to verify its energy efficiency	PE049
16	Lower utility bills	PE049
77	Other	PE049
88	Don't Know	PE049
99	Refused	PE049

PE049 I'm going to read you a few brief statements, and ask you to rate each of them on a scale from 0 to 10, where 0 means you disagree completely, and 10 means you agree completely. [RANDOMIZE; READ STATEMENTS AND RECORD RATING]

1	0-10 Energy-efficient features in a new home cost more than they're worth	OS_REC
2	0-10 It takes too much time and hassle to find information about energy efficiency when I'm buying a home	OS_REC
3	0-10 I have a hard time believing energy efficiency information provided by new home builders	OS_REC
4	0-10 To interest me in energy-efficient features, the added cost of these measures would have to be rolled into the mortgage.	OS_REC
5	0-10 I am willing to invest in home features that will reduce my monthly energy bills.	OS_REC
88	Don't Know	OS_REC
99	Refused	OS_REC

ONSITE RECRUITING

TO SCHEDULE ONSITE VERIFICATION

As we've discussed, the residential new construction program is an important component of California's ongoing efforts to save energy and reduce emissions affecting climate change.

Ask if &HomeType = 0 or 2 or 3

Based on the answers you've given in this survey, your home sounds perfect for an onsite visit. If you agree to participate an engineer will contact you in the next month to schedule an appointment to come to your home to gather information on the measures installed in your new home. We are offering a $50 gift card to Home Depot to participating households. The visit will take approximately 1 hour to complete, and we will schedule it at you convenience.

OS_REC Would you be interested in participating in this project?

1	Yes	OS_NAME
2	No	T&T
88	Refused	T&T
99	Don't know	T&T

OS_NAME May I please have your name so our technician can call you to set up an appointment time?

&OS_NAME	NAME OF PRIMARY CONTACT	OS_PHONE
88	Refused	T&T
99	Don't know	T&T

OS_PHONE May I also have the best phone number for the technician to reach you?

&OS_PHONE	PHONE FOR PRIMARY CONTACT	OS_APPT
88	Refused	T&T
99	Don't know	T&T

OS_APPT What are usually the best times to reach you?

&OS_Appt	PHONE FOR PRIMARY CONTACT	OTHER
88	Refused	T&T
99	Don't know	T&T

TO SCHEDULE INSTALLATION OF METERS

Ask if &HomeType = 0 and OS_REC = 1

Great, thank you for agreeing to help with this important study. Would you also be willing to have electrical metering equipment installed when our engineer visits. Our engineer will, while completing the survey of your house, install metering devices on your air conditioning units. The metering equipment is not invasive, and will be installed in an unobtrusive place and would be removed by us at the end of the research project. We expect the installation visit to take about two hours. We are currently offering an additional $50 gift card to household who agree to have metering equipment installed. Note, the electric use data will be used strictly for the study of the Residential New Construction Program and will not affect your electric service at all. The tests will also include testing the amount of leakage that your house and ducts have. In order to get accurate measurements, the engineers will need to tape your air conditioning vents during the 30 minute test. You will need to sign a brief participation agreement.

Ask if &HomeType = 1

Based on the answers you've given in this survey, your home sounds perfect for an onsite visit. If you agree to participate an engineer will contact you in the next month to schedule an appointment to come to your home to gather information on the measures installed in your new home and to have electrical metering equipment installed. Our engineer will, while completing the survey of your house, install metering devices on your air conditioning units. The metering equipment is not invasive, and will be installed in an unobtrusive place and would be removed by us at the end of the research project. We are offering a $10 gift card to Home Depot to participating households. We expect the installation visit to take about two hours. The tests will also include testing the amount of leakage that your house and ducts have. In order to get accurate measurements, the engineers will need to tape your air conditioning vents during the 30 minute test. Note, the electric use data will be used strictly for the study of the Residential New Construction Program and will not affect your electric service at all. You will need to sign a brief participation agreement.

M_REC Are you interested in participating in this project?

1	Yes	OS_NAME
2	No	T&T
88	Refused	T&T
99	Don't know	T&T

Ask Only if &HomeType = 1

OS_NAME May I please have your name so our technician can call you to set up an appointment time?

&OS_NAME	NAME OF PRIMARY CONTACT	OS_PHONE
88	Refused	T&T
99	Don't know	T&T

Ask Only if &HomeType = 1

OS_PHONE May I also have the best phone number for the technician to reach you?

&OS_PHONE	PHONE FOR PRIMARY CONTACT	OS_APPT
88	Refused	T&T
99	Don't know	T&T

OS_APPT What are usually the best times to reach you?

&OS_Appt	PHONE FOR PRIMARY CONTACT	END
88	Refused	T&T
99	Don't know	T&T

END.	Those are all the questions I have for today. Thank you for you time and help in this important study.	

APPENDIX E: Questions and Answers in Response to the July 8, 2008 Draft Scoping Study and Work Plan

1	**Author: Robert Kasman**	**Subject: Attribution**	**Pages 35-36**
Question	Phase I and Phase II list tasks: Attribution Analysis, "Sift through the evidence collected to make a case regarding the role of utility RNC programs in causing the observed market effects." I sympathize with the evaluators that this seems like an impossible task to complete with any quantitative level of precision or repeatability. If it is possible, can the plan explain in more detail how this key task will be implemented?		
Answer	Phase I is qualitative, based on the "preponderance of evidence" from measuring indicators associated with expected outcomes from program activities. Phase II is quantitative, as it will entail defining the hypothetical baseline—what would have happened in the absence of the RNC programs—and the difference between the baseline and what actually happened. The scoping study and work plan focuses on Phase I.		
2	**Author: Robert Kasman**	**Subject: Definitions, Net, Gross, spillover, etc.**	**Page 36**
Question	RNC efficiency programs are generally not widget based, and there exist some evaluation terminology subtleties. For the purposes of clarity, could you define, in the context of new construction, key terms as appropriate, such as "net savings, gross savings, and spillover?"		
Answer	Footnote #3 defines participant and non-participant spillover. In the final version of the report, we will either refer to a publicly available document where definitions of net savings and gross savings may be obtained, or we will define those terms within the scoping study and work plan.		
3	**Author: Robert Kasman**	**Subject: Task 1-4: Historic trends in IMC**	**Page 49**
Question	If this could be determined with any meaningful degree of accuracy it would be valuable, but determining current IMCs in new construction has proven to be very difficult. The IOU's have recently completed a study of SF RNC IMCs and energy savings. If we are able to do so, would the evaluators be interested in seeing the results of that study? Also, how do the evaluators define IMC in the NC context?		
Answer	Yes, we would be very interested in seeing the results of the IOUs' incremental measure cost (IMC)/savings study, and would consider using the results to help measure incremental costs. The market effects study will not include a full-fledged incremental measure cost study, but rather will focus on builders' and other market actors' perceptions of incremental measure and building costs, because such perceptions would be important in driving their decisions to incorporate energy efficient techniques and technologies into new home construction.		
4	**Author: Robert Kasman**	**Subject: Task 1-3: historic trends**	**Pages 48-49**
Question	This would be valuable if it can be established, but what will the evaluators do in cases where past studies did not estimate homebuyer efficiency awareness/trends? How will changes in homebuyer trends be attributed to efficiency program interventions?		

Answer	It is true that there will be gaps in the historical records. In such cases it may be that current measurements of certain indicators would be sufficient, without any historical trends, to assess program influence. Also, the "preponderance of evidence" approach, looking at indicators of multiple outcomes, allows for the discernment of patterns even where gaps exist. During Task 1—Analysis of Market Evolution—our intent is to reconstruct historical trends in practices, awareness, and attitudes (including those of homebuyers), not to establish attribution. Establishing attribution involves no hard and fast rules, but rather a process of looking for consistency among indicators and seeking to eliminate alternative explanations for observed changes.		
5	**Author: Robert Kasman**	**Subject: Market and Logic Models**	**Page 28**
Question	The RNC market and IOU logic model (p. 28), and links between boxes, is a cornerstone of the evaluation plan. Is the evaluation team open to revisions to this diagram?		
Answer	Yes, the team would be willing to consider changes to the RNC market and program theories and logic models, given a good rationale for the changes. We are especially interested in knowing what is missing from the logic models.		
6	**Author: Robert Kasman**	**Subject: Single and multifamily?**	**Page 1**
Question	The introduction states one objective is to "Understand the market effects... for new single-family homes." but later (page 82) references multifamily. Can you clarify is this study for SF, MF or both?		
Answer	The market effects study focuses only on single family new home construction. We will correct any inconsistencies before issuing the final scoping study and work plan.		